GREEN GROWTH TOOLBOX

Nature-based Planning Solutions

A Guide for Planners, Communities, and Developers

WHAT IS GREEN GROWTH?

***Green Growth** means conserving wildlife, habitat, and other valuable natural resources as communities continue to grow.*

Green Growth Toolbox Handbook Third Edition, 2023

Cover photos: bog turtle, Jeff Hall, rural cluster development in N.C., urban green infrastructure Raleigh, N.C., Ken Taylor, centralized development pattern, Murphy, N.C., McSween Photography, wild turkey, Dimus

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COLLABORATORS

INTRODUCTION AND SUMMARY

Welcome to The Green Growth Toolbox, a cooperative, non-regulatory effort led by the Habitat Conservation Division of the North Carolina Wildlife Resources Commission. The Toolbox provides North Carolina towns, cities, and counties with tools, land use planning methods, and case studies to conserve wildlife and natural resources as they grow.

To use the Green Growth Toolbox:

- Read the handbook and download the GIS dataset from the project website.
- Local government staff, officials and consultants can enroll in training workshops.
- Communities that participate can receive priority follow-up technical guidance.
- Individual town, city and county governments can exhibit innovative leadership.
- Communities in need of funding for this kind of planning may be eligible for cost-share financial support through our Partners for Green Growth program.

With initiative, creativity and support for "Green Growth," North Carolina communities can stem the decline of our wildlife heritage while continuing to develop. In addition to reducing impacts to wildlife, Green Growth can bring significant economic and social benefits to communities.

Here is what you will find in the Green Growth Toolbox (GGT) Handbook.

SECTION 1. The Green Growth Toolbox: How it works and why it is needed

- Over the next 20 years, 1.9 million people will move to North Carolina. This population growth is fueling sprawling patterns of land development that threaten North Carolina's environment, public health, and quality of life.
- The North Carolina Wildlife Action Plan identified sprawling patterns of land development as a top threat to over one third of wildlife species in our state.
- Extreme weather related to climate change is impacting both communities and wildlife. The protection of wildlife habitat increases resiliency against climate-related weather hazards for communities.

The N.C. Wildlife Resources Commission developed the GGT to help communities conserve priority wildlife habitats for future generations while continuing to grow.

SECTION 2. Using Conservation Data: Wildlife habitat and natural resource maps and data explained

- Learn what the data mean, how to use maps in: site selection, and the three levels of planning: visioning and plan making, ordinance and rule setting, and development design and review.
- Learn how to start a community-wide natural resource inventory.

SECTION 3. Habitat Conservation Recommendations: What the science tells us about how to minimize impacts to wildlife habitat

We recommend doing what is possible to incorporate these habitat conservation measures into the three levels of land use planning.

- Recommendations are non-regulatory and come from an expert review of the scientific literature regarding how much habitat wildlife need in developing landscapes.
- These recommendations are based on the NCWRC guidance document, "Conservation Recommendations for Priority Terrestrial Wildlife and Habitats in North Carolina."
- Explore options for greenway design, stream buffers, habitat open space standards and other conservation measures for priority areas.

SECTION 4. Green Planning: Enabling wildlife conservation in visioning and planning

"Green planning" means crafting a vision, goals, and strategies in planning documents specific to conserving important species, habitats, and ecosystems while continuing to grow.

- Learn a six-step process for creating a jurisdiction-wide conservation plan.
- Apply this process to write habitat conservation sections for existing land use plans.
- Link to examples of "green planning" documents from communities around the U.S.

SECTION 5. Greening Incentives and Ordinances: Incentives and policies necessary to achieve green planning goals

"Greening incentives and ordinances" means using Conservation Data to design incentives, land use districts, and development standards that minimize habitat fragmentation.

- Consider types of incentives that reward development projects for minimizing impacts to wildlife and natural resources, such as density bonuses.
- Update development ordinances to minimize impacts to priority habitats.
- Explore example incentives and ordinances from around the U.S., including those that better protect communities through habitat conservatoion in hazard prone areas.

SECTION 6. Greening Development Site Location, Review and Design: Siting, designing and reviewing development projects to minimize impacts

"Greening Development Review" means using conservation data and habitat conservation recommendations to site, review, and design developments.

- This section can benefit planning staff and advisory boards that review development proposals. It can also benefit developers, engineers, consultants, and landscape architects that want to design conservation areas in developments.
- See a visual step-by-step example of interpreting and using conservation data in development review, and site design.
- Use links to explore developments that embody many green growth principles.

The Green Growth Toolbox is funded by State Wildlife Grants and the N.C. Nongame and Endangered Wildlife Tax Check-off Fund.

SECTION 1

SECTION 1. THE GREEN GROWTH TOOLBOX

ANNE OUTLAW *wood thrush chicks*

PROJECT OVERVIEW

Land Use Planning Methods to Conserve Priority Habitats

Wildlife and plant species are our canaries in the coal mine. Their abundance and diversity indicate the health of our natural resources and warn us of threats to our own economic and physical health. Hundreds of North Carolina wildlife species are declining in population due to fragmentation and loss of habitats. Habitats are the natural areas that our communities depend on for clean water and protection from flooding or drought, among other benefits. The Green Growth Toolbox is a technical assistance tool designed to help North Carolina's counties, towns, and cities grow in ways that maintain priority wildlife and habitats. We all need a place to live and work and development can be done in a way that stewards our wildlife and natural resources.

The Toolbox includes how-to information on the following topics.

1. **The Justification and Benefits of Green Growth**
2. **Using Conservation Data** (maps & data about priority wildlife habitat) in site selection and planning activities.
3. **Understanding Habitat Conservation Recommendations and Best Practices**—and how to use them in each level of planning. Detailed information is in Section 3.
4. **Green Planning**—to create land use plans that will enable conservation of your community's natural assets.
5. **Greening Incentives and Ordinances**—encouraging conservation and structuring local ordinances and standards to conserve, buffer, and connect important habitats as growth occurs.
6. **Greening Development Review and Site Design**—by using conservation data and recommendations to review site location and development proposals.

What are
conservation data?

Conservation data are maps and other information about the conservation status of important wildlife and plant species and their habitats. The data come from many NC agencies and are best suited to land use planning and community climate resilience. NC has comprehensive data available for all communities.

How it Works

The Green Growth Toolbox consists of a handbook, packaged GIS dataset, training workshops, and technical assistance. Some cost-share funding is avalailable to conservation-based planning projects that qualify, through our Partners for Green Growth program. All resources are available for download from our website. www.ncwildlife.org/greengrowth

This project is a cooperative, non-regulatory effort led by the Habitat Conservation Division of the North Carolina Wildlife Resources Commission in collaboration with organizations featured in the acknowledgements.

Training Workshops and Presentations

The Green Growth Toolbox is introduced to local government staff, advisory boards, and consultants through a training workshop. Brief presentations can also be delivered to town councils, boards of commissioners, and other decision makers. Local government officials or planning staff who want to use the GGT can request a training workshop.

Technical Guidance

Local government officials and planning staff who have participated in the GGT workshop are priority to receive free technical guidance on the following topics.

- Integrating the Conservation Data with your community's GIS database.
- Creating habitat and natural resources maps for local planning.
- Non-regulatory review of conservation plans, land use plans, ordinances, policies and development designs.
- Incorporating habitat conservation into:
  - land use plans,
  - policies and ordinances, and
  - development review, and site design.
- Developing habitat management plans for parks and open space.

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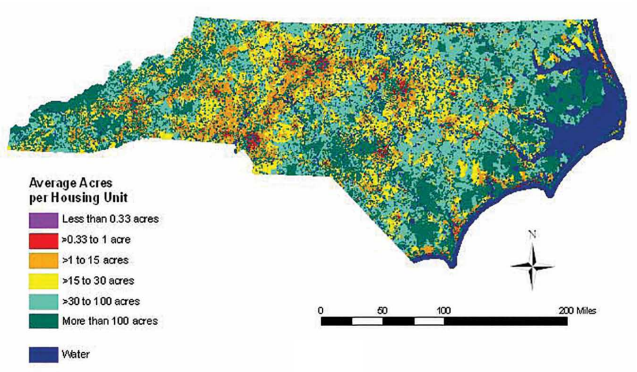
North Carolina has more sprawling development patterns than any other state.[1]

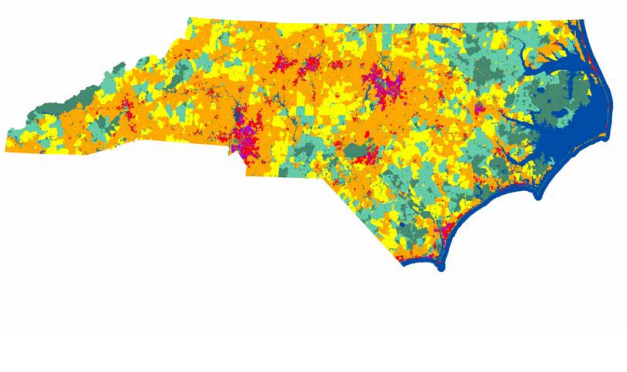
North Carolina's Challenge

North Carolina is facing unprecedented population growth and inefficient land development patterns that are putting pressure on the health of our natural resources.

Housing Density 1990



Projected Housing Density 2050



GRAPHICS COURTESY OF CONSERVATION TRUST FOR NORTH CAROLINA AND DR. VOLKER RADELOFF, UNIVERSITY OF WISCONSIN-MADISON

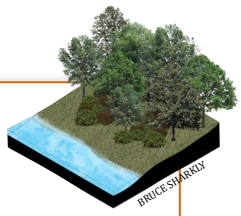
Suburban sprawl is generally defined in most literature as areas with 0.33 to one development unit per acre and where development uses are not mixed. Exurban or rural sprawl is generally defined as having one development unit per one to 20 acres, where farms and forests are converted to low density development on large lots.

Land Development and Population Growth in NC

- According to the U.S. Census Bureau, North Carolina is consistently among the top ten fastest-growing and most populous states in the country.[2]
- Between 2010 and 2020, our population grew from 9,535,483 to 10,439,483, an increase of 903,905 or 9.5 percent. The projected increase is 3.2 Million more people by 2050.[3]
- This population growth is fueling patterns of land development that threaten our environment, health, quality of life, and wildlife habitat. Instead of concentrating development in town and city centers, our communities are spreading outward and using land less efficiently. These commonplace, spread-out development patterns can cost twice as much in property taxes[4] compared to centralized growth.
- One acre of land was developed per new resident as recently as 2007.[5] Now one half acre of land is developed for each new resident in North Carolina (1992 - 2017). Our major cities developed over five times more land per new resident in 2010 than in the 1970s.[6] Our land mass is 34.5 million acres on which we also accommodate agriculture and natural areas as well as development and in 2017 4,915,800 acres (14%) was classified as developed. Our population growth rate is comparable to the growth rate in developed land.[7]
- In fact, North Carolina contains more sprawl regions: the Triangle, the Triad, and the Charlotte metro area, than any other state.[8]
- On average since 1992, 67,000 acres of forests and fields are developed each year [9]—an area the size of Durham, NC.
- Over 25 percent of streams sampled for water quality are classified as impaired and do not meet standards for safe drinking water or their best use.[10]

The Status of Our Wildlife Species and Habitats

- Of more than 1000 wildlife species found in North Carolina, over 483 species are of conservation concern including 46 species already federally endangered or threatened and 256 species that are state endangered or threatened.[11]
- North Carolina contains eight of the 21 most endangered ecosystems in the United States—including spruce-fir forests, longleaf pine forests, and forested wetlands.[12]



What is **habitat?**

Habitat is the natural environment that plants and wildlife need to survive. Streams, forests, rock outcrops, beaches, wetlands and fields are habitat types. Many wildlife of conservation concern need unique habitats and are declining due to habitat loss.

Examples of Impacts to Wildlife and Habitat from Development Patterns[13]

Habitats are reduced and fragmented by roads and other development.


DIRK STEVENSON

softshell turtle

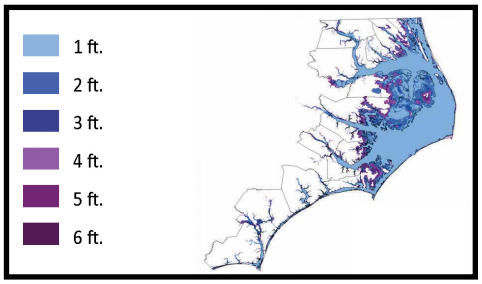
- Many songbird species are steadily declining with the loss of large areas of forest of 75 to 500 acres or more in the United States. Predation by feral and domestic cats and collisions of songbirds with tall structures, during migration, are also major factors.
- Amphibians and reptiles experience almost 100 percent mortality when crossing roads with over 2000 cars per day (1.4 cars per minute).
- Bald eagles[14] and colonial nesting waterbirds[15, 16] often abandon their nests when development takes place during the nesting season within 330 feet or more of their nests.
- Tiger salamanders, Carolina gopher frogs and Bachman's sparrows are examples of fire-dependent species. Without regular low-intensity fires in their longleaf forest habitat, they will become extinct. Because of this and other reasons, contiguous stands of natural longleaf pine forest that are > 2,000 acres in size are needed.

Fire is a natural process. What is **prescribed fire?**

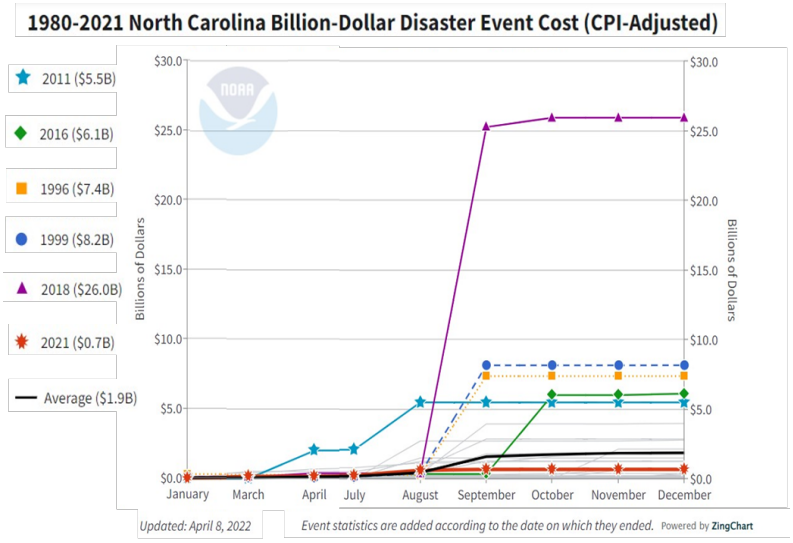
Most plant and wildlife species actually need occasional brush and forest fires. Fire happens naturally through lightning strikes. It clears out thick vegetation growth allowing plant seeds to germinate on bare mineral soil and receive enough sunlight to grow. This improves forage and habitat. We can't allow fire to happen naturally now, very often. Occasional controlled burning, also called prescribed burning, conducted by professionals, is used to maintain fire disturbance for habitat management while keeping risk to people low. Prescribed fire also protects our communities from wildfires that happen due to woody fuel build-up from lack of occasional fire. Climate change is expected to increase the intensity of wildfires. For more information, see the N.C. Prescribed Fire Council at www.ncprescribedfirecouncil.org.

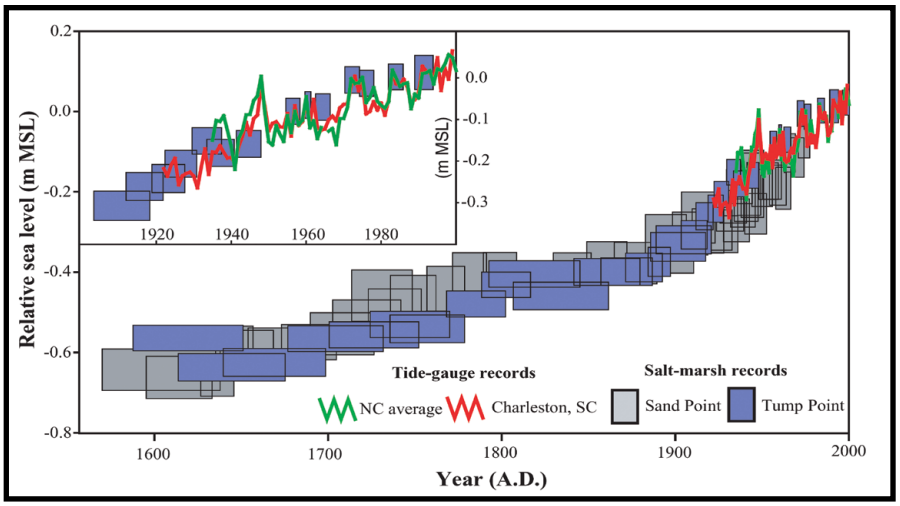
The Increased Need for Safeguards: Climate Change and Sea Level Rise

- North Carolina experiences more billion-dollar climate and weather disasters than 43 other U.S. states and these events have been increasing in recorded frequency since 1980.[17]
- According to the State Climate Office of North Carolina (led by N.C. State University), the evidence of Global Climate Change is compelling and we can expect extreme weather events to increase in the future.[18]
- Sea level in North Carolina is reported to have risen 13 inches over the last century. Independent studies show that the rate of sea level rise increased 2 to 4 times over the last century.[19]
- The N.C. Coastal Resources Commission Science Panel concluded by consensus that a 3.3 foot increase in N.C. sea level is likely by 2100.[20]
- Climate change will likely cause increases in flood events and droughts in parts of our state.[2122]



Division of Coastal Management (2011). North Carolina coastal elevations from one to six feet. All areas in blue (up to three feet) would be submerged by 2100 if sea level continues to rise at observed rates. Inland flooding from storm surge and salt water intrusion would also result from increased sea level.[21]





Kemp et al. 2009. Reconstructed measured sea level along North and South Carolina. "Relative sea level (m MSL)" in graph is meters of mean sea level relative to the present. In 1900 sea level was about 0.32 m (13 inches) below present. The rate of sea level rise increased in the last century two to four fold over the rate from 1600 to 1900. [22]

diamondback terrapin WILLEM M. ROOSENBURG

chestnut-sided warbler PLANETOFBIRDS.COM

Wildlife Habitat Improves Community Resilience to Extreme Weather

Healthy large, connected blocks of wildlife habitat can reduce threats to life and property during extreme weather events because they can better absorb water and thereby reduce impacts like floods, fire, and drought. As such there are many safety and economic benefits.

- Heavy rains are expected to increase in the future due to a warming climate. As a result, water is higher and runs faster in streams and rivers. Maximizing the amount and size of forests along waterways and wetlands will slow water down so flooding and drought are reduced and aquifers are recharged.[23]
- Investment in natural infrastructure (wetland and forest restoration and conservation combined with water control structures) is less expensive, faster to build, and would lead to 14 percent or 1.5 foot water level flood reduction during major hurricanes.[24]
- Use nature to build back stronger - Coastal habitats, such as beaches, dunes and marshes, will be lost more rapidly than is natural, altered by rising sea level, increased storm surge and salt water intrusion. As communities rebuild, if houses are set-back far enough from dunes and marshes, these protective habitats will have space to migrate inland so new homes can be protected from the next hurricane.
- Healthy habitats and natural areas are considered part of our "natural climate solutions" which can help provide one-third of the climate mitigation needed to prevent catastrophic sea-level and weather events. In NC, forests currently absorb 25% of NC's greenhouse gases (GHG) emissions. Certain habitats are very efficient at absorbing GHG. For example, if peat-soil wetlands of the coastal plain were restored to hold more water, over the next 100 years they could capture 25 percent more GHG.[25]

The Land Use Planning Gap

A critical gap in land use planning underlies these problems. Many communities in North Carolina lack adequate access to and training on how to incorporate wildlife and habitat conservation strategies in local and regional planning.

The Critical Role of Land Use Planning

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Land use planning will play a critical role in helping to safeguard our communities and make them more resilient to extreme weather events. Likewise, land use planning can help to make wildlife habitats and populations more resilient to the common threats we may face.

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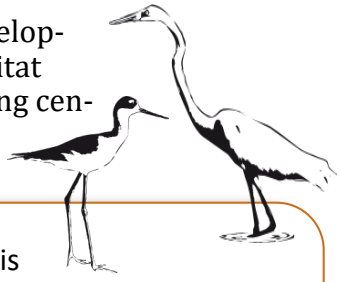
The Green Growth Solution

The Green Growth Toolbox bridges the land-use planning gap by providing recommended planning measures that will conserve valuable biodiversity and habitat without preventing necessary growth.

GREEN GROWTH PAYS DIVIDENDS: BENEFITS TO COMMUNITIES

Green Growth is a way to encourage wildlife habitat conservation while developing communities. It means more centralized growth that also conserves habitat and biological diversity while building homes, roads, businesses and shopping centers.

The N.C. Wildlife Resources Commission and its partners encourage you to put the Green Growth Toolbox to work to benefit local wildlife, habitats, communities and economies. Green Growth will pay dividends for generations to come—dividends that our children, grandchildren and great-grandchildren will need and enjoy.



What is
biological diversity?

Biological diversity (or biodiversity) is the entire diversity of life—including individual species, habitats, and entire ecosystems—in a given area.

Ten Ways Green Growth Benefits Communities

BENEFIT #1 Better health all around: Green Growth leads to healthy communities.

The streams, rivers, soils, plants and animals in North Carolina's counties, cities and towns are part of complex ecosystems upon which our lives depend. Healthy ecosystems function well because they have more wildlife and plant species to support our web of life. When a community's biological diversity is maintained, healthy ecosystems support human health and the negative effects of disturbances are minimized. For example, without enough trees on the edge of streams, our waterways die because all aquatic life, including fish, depend on tree leaves for the base of their food chain. Without aquatic life that naturally break down pollutants and harmful bacteria, our waterways pose risks to human health.

Natural areas benefit our health in other ways as well.

- Research at East Carolina University found that North Carolina communities with access to natural areas have lower rates of obesity.[26]
- Spending time experiencing nature is commonly shown to reduce stress and depression, [27, 28] the leading causes of lower economic productivity.[29]
- Richard Louv's book, "Last Child in the Woods," demonstrates that some growing childhood behavior problems and obesity are linked to spending less time in nature.[30]

BENEFIT #2 Economic returns: Green Growth helps communities maintain ecosystem services, which can have significant economic returns.

Natural ecosystems provide us with trillions of dollars' worth of "free" services—flood control, water and air purification, crop pollination, and climate regulation.

What are
ecosystems & ecosystem services?

An ecosystem contains one or many types of habitat. An ecosystem is a natural system of all wildlife and plants that depend on one another for survival. Interactions among species and their environment in an ecosystem help to create human benefits as well. Through predation and uptake of nutrients, wildlife and plants clean our water and keep our forests, soils, fields, and crops healthy. Forests and wetlands provide flood control and help to prevent drought. These and other benefits are called ecosystem services, which make up our natural life support system.

- For every job funded by investment in natural infrastructure to reduce flooding, four additional jobs and a 2:1 increase in gross product would be created in the region.[31]
- One study estimated the value of these ecosystem services worldwide at $33 trillion per year—about the same as the world's gross domestic product.[32]
- NC's natural areas and working farms and forests removed 25% of the state's greenhouse gas emissions in 2017.[33]
- Clean energy creates more jobs and costs less.[34]
- Natural stormwater management, water filtration and air purification provided by nature preserves, stream buffers and trees in Charlotte and Mecklenburg County are valued at over $4.4 billion in avoided stormwater construction and $64 million in annual air purification.[35]
- New York City does not need to filter most of its drinking water because it receives most of it from the Catskills which is over 60% forested. This saved taxpayers over $8 billion in construction costs and $300 million in annual operating costs of a water filtration plant that is not needed.[36, 37]
- In North Carolina, natural parks in Mecklenburg County generate five times more economic benefits (annually valued at $15 million) than they cost.[38] North Carolina public lands generate four times more economic benefit than their acquisition cost.[39]
- North Carolina National Wildlife Refuges provide $166 million per year in ecosystem services.[40]
- Bats contribute $4 and $53 billion per year to U.S. agriculture by feeding on insects that are harmful to crops.[41]
- Two-thirds of US crop pollination comes from native bees, not domesticated honey bees.[42] Native non- domestic insects contribute $57 billion per year to agriculture through pollination, predation and nutrient cycling.[43]

If ecosystems that provide these services are degraded, communities will need to spend an unreasonable amount of money to engineer and restore these services.

Green Growth Helps Minimize Drought Problems

Stream erosion results from stormwater runoff, which exacerbates drought.

Sprawling development exacerbates drought conditions. Impervious surfaces force water to flow out of a region rather than recharging groundwater.

- Between 1982 and 1997, the N.C. Triangle Region lost between 9.4 and 21.9 billion gallons of water to runoff from impervious surfaces.
- Similarly, the Charlotte metro region lost between 13.5 and 31.5 billion gallons and the Greensboro region lost between 6.7 and 15.7 billion gallons.44

By minimizing sprawling development patterns and impervious surfaces, communities can better avoid losing water and reduce the effects of future droughts.

Research shows us that protecting quality ecosystems, which possess the highest levels of biodiversity in a given area, ensures that the widest range of ecosystem services is maintained.[45]

BENEFIT #3 Environmental safeguards: Green Growth practices help your community mitigate damages from natural disasters, flooding, drought and climate change.

Natural disasters cost taxpayers and businesses exorbitant amounts of money to clean up. Communities can avoid many expensive outcomes by protecting wildlife habitat in hazard prone areas, which reduces the effects of natural disasters.

- Inland and coastal flooding is reduced by approximately the same proportion as there are forests in the river basin in the Mississippi Alluvial Valley. This means for every 1 percent of reforestation, floods are reduced by approximately 1 percent.[46]
- North Carolina receives $160 million on average annually in federal funds to buy-back flood- damaged properties in the floodplain.[47] Less money could potentially be spent to reforest and conserve forest upstream.
- For every dollar spent on prescribed fire to improve wildlife habitat and protect against wildfires, $2.14 was saved in wildfire fighting and property damage reduction.[48]
- Southern pine beetles cause up to $38 million of economic loss annually in North Carolina.[49] Woodpeckers have been shown to feed on up to 63% of adult southern pine beetles in forests, significantly reducing infestation.[50]
- Oyster reefs and marshes act as natural barriers to waves; 15 feet of marsh can absorb up to 50 percent of incoming wave energy.[51]
- Wetlands prevented $625 million in property damages during hurricane Sandy and reduced flooding on 1,200 miles of roads. Annually they can provide a 20% reduction in annual storm damage.[52]
- Compared to engineered structures, wetland and reef restoration in the Gulf of Mexico is more cost-effective. For every $1 spent wetlands and reefs provided $7 of flood protection benefits.[53]
- It is estimated that coastal wetlands have an economic value of $25.6 billion/yr for structure protection during hurricanes.[54]

BENEFIT #4 Streamline the permitting process and avoid environmental conflicts: The Green Growth Toolbox can help developers and your community avoid conflicts and environmental permit delays.

Public administration research demonstrates that environmental policies that reduce uncertainty actually enhance economic growth. With less uncertainty companies are more likely to invest.[55]

Use of the methods included in the Green Growth Toolbox can help your community pro--actively address streams, wetlands, and endangered species issues. The Green Growth Toolbox can also help developers put sound conservation measures in place before the environmental review process, such as wetlands permitting, is initiated. While use of the Green Growth Toolbox cannot guarantee a permit outcome, when conservation measures are in place ahead of time, permits take less time.

BENEFIT #5 Attract new-economy businesses: By preserving high-quality and attractive green spaces, Green Growth can draw workers and businesses of the new economy to your community.

- In national and regional surveys, new economy companies rate natural amenities and environmental quality ahead of housing costs, cost of living, commuting patterns, schools and public safety in making decisions about where to locate. Businesses value greenways and their recreation opportunities because they decrease the health care costs of their employees.[56]
- Greenways attract recreation related businesses and improve quality of life.[57] Grand Forks, North Dakota restored the natural floodplain to prevent flooding and built a greenway to enhance economic development. *Cabella's* specialty retailers located a store near the greenway and doubled their retail sales expectations. Each greenway event generates $2.7 million in economic activity.[58]

The Cost of Sprawl

Studies on ***Cost of Community Services*** have shown that sprawl is far more expensive than compact development combined with protection of natural areas. If communities around the United States concentrated growth in city centers, it would save taxpayers the following amounts ANNUALLY through 2025:

- $110 billion in road infrastructure,
- $12.6 billion in water/sewer infrastructure and
- $4.2 billion in other public service costs.[59]

Did you know that most residential development in North Carolina actually costs local governments more than what is covered by property taxes?

For example:

- Residential development in Alamance County contributes 68 cents to the county for every dollar of public services used. That's a 32 percent average LOSS to the county.
- On the other hand, farm and forestland in Alamance County contribute $1.69 to the county for every dollar of services used. That's a 69 percent gain![60]

BENEFIT #6 Increase prosperity: Incorporating Green Growth practices into development site design can increase property values, produce more profitable developments, and increase the economic competitiveness of a community.

- It is important to buffer sensitive habitats from development with parks and natural areas so that development does not occur directly on the edge of a the habitat. Buffering sensitive habitats with greenways and parks near development can increase property value.
- In Apex, North Carolina, homes in the Shepherd's Vineyard development adjacent to the American Tobacco Trail sold for $5,000 more than other homes in the neighborhood.[61]
- In Brown County, Wisconsin, lots adjacent to the Mountain Bay Trail sold faster and for an average of nine percent more than similar property located away from the trail.[62]
- Homes within walking distance of natural parks sell for up to 20 percent more.[63] Larger parks are better for property values even in rural areas.[64]

Conservation developments are cheaper to build than conventional subdivisions[65]

- In South Carolina, the costs of developing a 96-acre parcel in a conventional pattern were $10,000 more per lot than the cost of a conservation subdivision.[66]
- Analyses of recent major conservation subdivisions demonstrates an overall savings of 36 percent verses conventional subdivisions, which provides an opportunity to build affordable housing.[67]
- Low impact development techniques to manage stormwater are dramatically and consistently less costly in the short and long-term due to less need for construction, maintenance and wastewater management. Savings range from 15 to 80 percent.[68,69]

Minimizing habitat impacts does not stop development

- Ten years after small wetlands conservation bylaws were passed in Massachusetts the rate of land conversion from wetland to residential uses decreased. However, there were no decreases in housing units, housing values or housing density in those communities.[70]
- Seventy-six percent of home-buyers do not regard having a lawn as a very important feature.[71]
- Ninety-one percent of home-buyers in the Charlotte, North Carolina, region consider environmentally friendly community features and landscaping to be important.[72]

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Adopting a Green Growth approach, therefore, can lead to more profitable, high-quality developments.

BENEFIT #7 Generate tourist income: Green Growth can help communities create responsible nature-based tourism opportunities.

Tourist dollars tied to nature-based recreation contribute substantially to North Carolina's economy. In 2011, 37 percent of North Carolinians participated in wildlife related recreation (primary purpose was wildlife sport or viewing) and $3.3 billion was spent by residents and visitors for this purpose. This is an increase of over 50 percent in spending from 2006.[73] Thirty percent of overnight visits in N.C. are for nature-related activities.[74] Protecting high-quality natural areas is a good investment in your community's tourism economy and the Green Growth Toolbox can help you identify the most valuable areas to protect.

BENEFIT #8 Reduce costs to taxpayers and local government: Green Growth can help local governments keep taxes low by reducing the cost of community services.

- Property taxes are twice as high when development is spread-out; a pattern similar to most of today's NC and US communities. Property taxes can be reduced by developing in towns and cities and not encouraging major subdivisions in rural areas.[75]
- Spread-out residential and low density development far from town centers is more expensive because utility construction, maintenance, and emergency services extend over greater distances.[76]
- For every 10 percent increase in forest and managed grassland cover in a watershed, water treatment costs decrease by 20 percent.[77]
- Stream restoration in North Carolina costs $1.2 million for every mile of stream.[78]
- By using hazard prevention policies that conserve wetlands, floodplain and surrounding upland habitat, fewer homes and businesses will require emergency services.

BENEFIT #9 Respond to public demand and promote your community: Green Growth helps local governments properly respond to citizen's conservation interests and this helps to attract new residents and businesses.

North Carolina citizens rank environmental protection as a high priority. In a 2005 public opinion survey, North Carolina residents felt it was very important to protect wildlife resources, even if it meant regulating land development.

- Of residents surveyed, 89% responded that it was very important that wildlife and natural areas exist in North Carolina for enjoying and experiencing nature.[79]
- In this same survey, citizens reported they were concerned that sprawl and over-development will negatively impact North Carolina's wildlife.[80]

Successful local bond referendums also show citizen support for habitat protection.

- Nine North Carolina towns and cities passed bond referendums totaling over $220 million to conserve land from 2005 to 2011.[81] Open space bond referendums remain popular.

BENEFIT #10 Innovative leadership: Leave a natural, economic and cultural legacy for future generations.

Our quality of life, our economy and our history come from and depend on the natural world. Using a Green Growth approach coupled with protection of property rights and effective economic development tools will comprehensively address the challenges of the future and enhance economic development. A Green Growth approach will help to leave a legacy for future generations that honors the responsibility to steward our wildlife, natural resources, economy and cultural heritage.

Resources for Conducting a Green Growth Benefits Analysis

For more on how your community can analyze the benefits of habitat conservation see:

- NC Cost of Community Services studies. It is best just to search this term online.
- InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs): a free suite of spatial tools to help communities understand the value of natural resources within their communities: https://naturalcapitalproject.stanford.edu/software/invest
- ITree A free suite of spatial tools to identify how trees and forested areas contribute to a variety of ecosystem services. www.itreetools.org
- Center for Neighborhood Technology: Green Value Stormwater Management Calculator calculates costs and benefits of LID techniques at a variety of site scenarios: https://greenvalues.cnt.org/#calculate
- A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction: A handbook to assist communities in making decisions about the use of green infrastructure to address current and projected flooding problems. https://coast.noaa.gov/digitalcoast/training/gi-cost-benefit.html
- Charlotte and Mecklenburg County, North Carolina, Urban Ecosystem Analysis by American Forests. http://charmeck.org/city/charlotte/epm/Services/LandDevelopment/trees/TreeCommission/
- NatureServe Vista is a free ArcMap 10 Extension based on CommunityViz that measures the benefits of conservation decisions for land use planning. www.nature serve.org/prodServices/vista/overview.jsp
- "Ecosystem Services in Cecil County's Green Infrastructure," is a county local government example. www.ccgov.org/dept_planning/DocsForms.cfm
- United States Business Council, Ecosystem Services http://usbcsd.org/case-studies/biodiversity-and-ecosystem-services-case-studies/

GETTING STARTED—TEN KEY STEPS TO GREEN GROWTH

How can your community get started with the Green Growth Toolbox?

1. Watch the recorded webinars on our website. Find out if Green Growth training workshops are offered in your region. If you work for a local government, then sign up! Contact us at greengrowth@ncwildlife.org.
2. Visit our website at www.ncwildlife.org/greengrowth. Download the Green Growth Toolbox GIS data package and begin using it in land use planning projects.
3. Establish a Conservation Commission or Environmental Review Board to help guide your community's Green Growth efforts.
4. Hire or assign a staff member to help implement and administer Green Growth projects in your community.
5. Develop a jurisdiction-wide strategic conservation plan. Work with conservation partners listed in Appendix B of the handbook to do this.
6. Meet cooperatively with neighboring municipalities, counties, and regional planning organizations to cooperatively craft Green Growth strategies.
7. Amend your comprehensive plan to include Green Growth maps, goals, and strategies appropriate for your community.
8. Streamline and enhance zoning and development ordinances to protect important species, habitats, and ecosystems without hindering growth.
9. Start using Green Growth data to review development proposals and encourage developers to create wildlife-friendly development projects.
10. Establish a land acquisition fund and partner with your local land trust to purchase the highest quality natural areas in your community.

Communities across the country are addressing our natural resource challenges and realizing the benefits of conserving valuable ecosystems through innovative land use planning.

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SECTION 2. CONSERVATION DATA

TODD PIERSON

ornate chorus frog

The Green Growth Toolbox explains how to conserve priority wildlife and habitats in your community through three levels of land use planning:

- Visioning and plan making,
- Incentives and ordinance and rule setting,
- Development review and site design.

To plan for Green Growth, communities need information and maps about important species, habitats and ecosystems in their jurisdiction. This section of the handbook describes the following for Geographic Information Systems (GIS) specialists and non-specialists:

- the three components of the Conservation Data for Green Growth,
- how to use the Conservation Data in site selection and the three levels of planning,
- and how to do natural resource inventories to supplement existing data.

THE CONSERVATION DATA FOR GREEN GROWTH

Available for download at www.ncwildlife.org/GGT

The Conservation Data for Green Growth is available for download from our website. It can also be viewed on N.C. Natural Heritage Program's Data Explorer.[a] Our training workshops provide detailed guidance on how to interpret this data.

The highest priority wildlife habitats in greatest decline listed below are described in the N.C. Wildlife Action Plan and are represented in the GIS data explained in this section.

- Beaches and estuarine islands
- Coastal wetlands
- Maritime forests
- Longleaf pine forests
- Small wetland communities
- Mountain bogs
- Early successional habitat (grasslands and shrublands)
- Floodplain forests
- Habitats at high elevation
- Caves/mines
- Rock outcrops
- Streams and key aquatic habitats
- Large unfragmented, undeveloped parcels
- Undeveloped tracts in close proximity to existing Managed Areas
- Important wildlife travel corridors (natural areas between priority habitat areas)

a https://ncnhde.natureserve.org/

Detailed information about priority habitats is available in the N.C. Wildlife Action Plan.[b] Habitat descriptions are also available on the NCWRC's website[c] at and in the Green Growth Toolbox regional appendices.[d]

There are 3 components to the Conservation Data for Green Growth.

- **Component 1** (11 map layers)–centers on using the Biodiversity and Wildlife Habitat Assessment (BWHA) map. This assessment is part of the N.C. Conservation Planning Tool. The BWHA and other map layers that were used to create the BWHA values are provided as part of this component.
- **Component 2** (8 map layers)–is comprised of map layers that the N.C. Wildlife Commission recommends be used in addition to the BWHA to give a complete picture of wildlife habitat conservation needs and opportunities in your community.
- **Component 3**– Additional regional information and map layers have been developed with more refined local data and appear as an appendix to the handbook if they are available in your planning area. See the map on page 36.

Collectively, these map layers constitute the Conservation Data for Green Growth. Check the quick reference chart beginning on page 42 for summaries about how to use the data and to find out which map layers are appropriate to use in each level of planning.

When possible, we recommend downloading or receiving data from the original source in order that you have the most up-to-date data. The boxes next to each map layer provide the original data title and source information.

What is the
N.C. Conservation Planning Tool?

The N.C. Conservation Planning Tool is based on green infrastructure principles, which emphasize the importance of maintaining an interconnected network of green space that conserves natural ecosystems and provides associated benefits to our communities.

- The Conservation Planning Tool (CPT) identifies and prioritizes, on a statewide scale, essential high-quality natural resources required to maintain healthy ecosystems.
- This analysis pinpoints areas that are already protected as well as those areas that represent gaps, which are areas that would be a priority for conservation but are not protected.
- The goal of this tool is to highlight areas of opportunity to collaborate on conservation of significant natural resources.

b https://www.ncwildlife.org/plan
c https://www.ncwildlife.org/Conserving/Habitats
d https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Conservation-Data/Regional-Data

ANNE OUTLAW

pine barrens treefrog

ANNE OUTLAW

marbled salamander

bobolink

COMPONENT I ▸ Biodiversity and Wildlife Habitat Assesment (BWHA)

Part of the N.C. Conservation Planning Tool

- GIS Raster File Title: bwha
- Original Source: NCNHP

- The Biodiversity and Wildlife Habitat Assessment[e] is a map that represents the highest priority areas for conservation of wildlife habitat and biodiversity in North Carolina.
- The BWHA is one map layer that is a composite 30 x 30 meter pixel grid comprised of most of the individual map layers used in the Green Growth Toolbox.
- The assessment is based on the best science and expertise from multiple sources. Areas with more rare, abundant and diverse species and habitats are rated as a higher conservation value on a scale of 10 to 1 in this map layer.
- The areas with a relative conservation value of maximum (10) to very high (7) are the most sensitive with the rarest species and habitats. These are the most important areas to conserve, buffer and connect for wildlife purposes.
- Areas with a rank of 6 to 1 are of high (6) to moderate (1) conservation priority. They play an important role in maintaining habitat connectivity and biodiversity but may not be as sensitive or rare as the higher ranked areas.
- The areas that appear as **grey** have at least 20 percent impervious surface and likely have the least habitat value. They have been assigned the value of –1.
- White areas are of unknown value and most have not been inventoried.
- Detailed information about the data used, the conservation value ranks, and methods used for the BWHA are provided through this link[f]

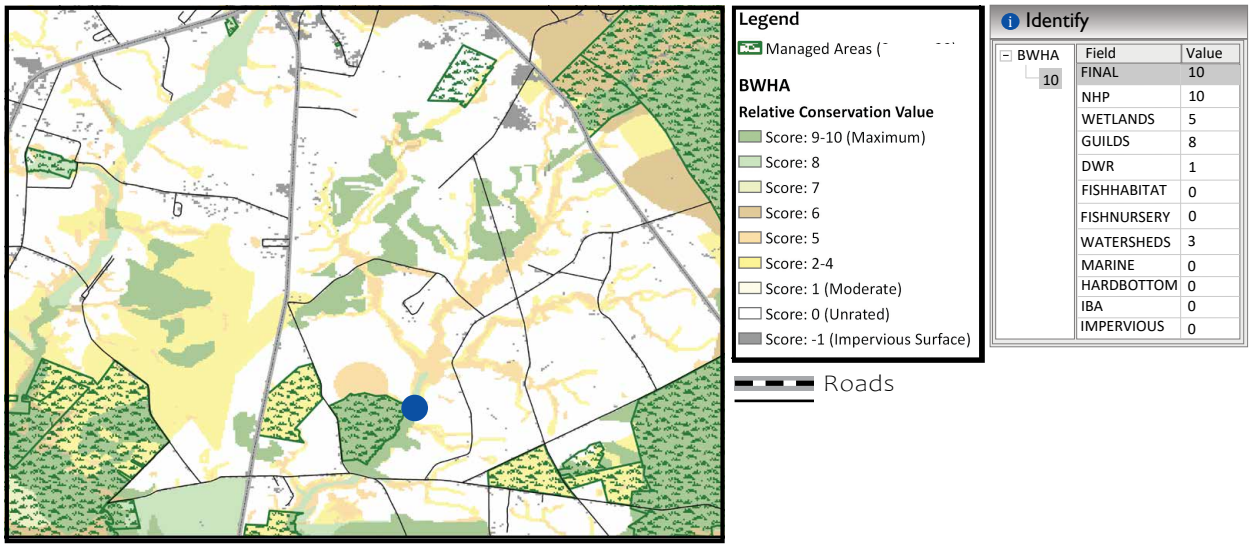
Recommended use of these data:

- To identify important habitats and potential wildlife travel corridors that can be used in transportation plans, land use plans and other plans, incentives and ordinances.
- At a fine scale, the boundaries of this layer may be inaccurate. We recommend using the individual component map layers in addition to the BWHA for development review and site design.
- If your conservation options are limited to only the highest priority areas, we recommend that the greatest conservation measures are placed in areas that rank from 10 to 7 in the BWHA. High priority areas can be connected by maintaining low density but clustered development in or outside low ranking areas.
- All areas with a value equal to or greater than 1 are very important to maintaining a healthy natural environment. Major development or major roads in these areas should be kept to a minimum as much as possible.

e https://ncnhde.natureserve.org/content/data-download

f https://www.ncnhp.org/biodiversity-and-wildlife-habitat-assessment

FIGURE 1. INTERPRETING THE BIODIVERSITY AND WILDLIFE HABITAT ASSESSMENT



- **When using the 'Identify' feature and clicking on the BWHA map layer in ArcMap or ArcMap Reader (free software available through our website) you will see the BWHA data table.**
- **A key to the BWHA legend and data table key is on page 37.**
- **The FINAL field shows the maximum Relative Conservation Value of 10. This value comes from the NHP (Natural Heritage Program) field value (10) which means that it is a Natural Heritage Area (see below). The value of the highest ranked feature is the FINAL value.**
- **Also at that location are other natural features including a wetland with a value of 5, which means the data come from the National Wetlands Inventory (NWI). Please note that on the Coastal Plain the Coastal Region Evaluation of Wetland Significance (CREWS) data is available and is more accurate.**

What GIS Data Make up the Biodiversity and Wildlife Habitat Assessment?

N.C. Natural Heritage Program Map Layers

The data below are provided by the N.C. Natural Heritage Program[g] (NCNHP), which is within the N.C. Department of Natural and Cultural Resources. NCNHP updates these data quarterly. To inquire about receiving regular updates, please contact the N.C. Natural Heritage Program Conservation Data Manager.

Natural Heritage Areas

(Formerly named *Significant* Natural Heritage Areas)

- Download GIS Shapefile: nha
- Original Source: NCNHP

Natural Heritage Areas[h] (NHAs) are identified by N.C. Natural Heritage Program ecologists. These sites support rare and high-quality populations of native plants, wildlife and natural communities (habitats) on both land and water and are extremely important to the conservation of our state's biodiversity. A site's value rating may be due to the presence of rare species, rare or high-quality natural communities or other important ecological features.[1]

Accuracy

All NHAs are based on field surveys. Field surveys are updated infrequently and some NHAs may have been destroyed. It is important to verify their status on-the-ground ahead of site

g http://www.ncnhp.org
h https://www.ncnhp.org/conservation/natural-areas

design or purchase.

Where can I find more information?

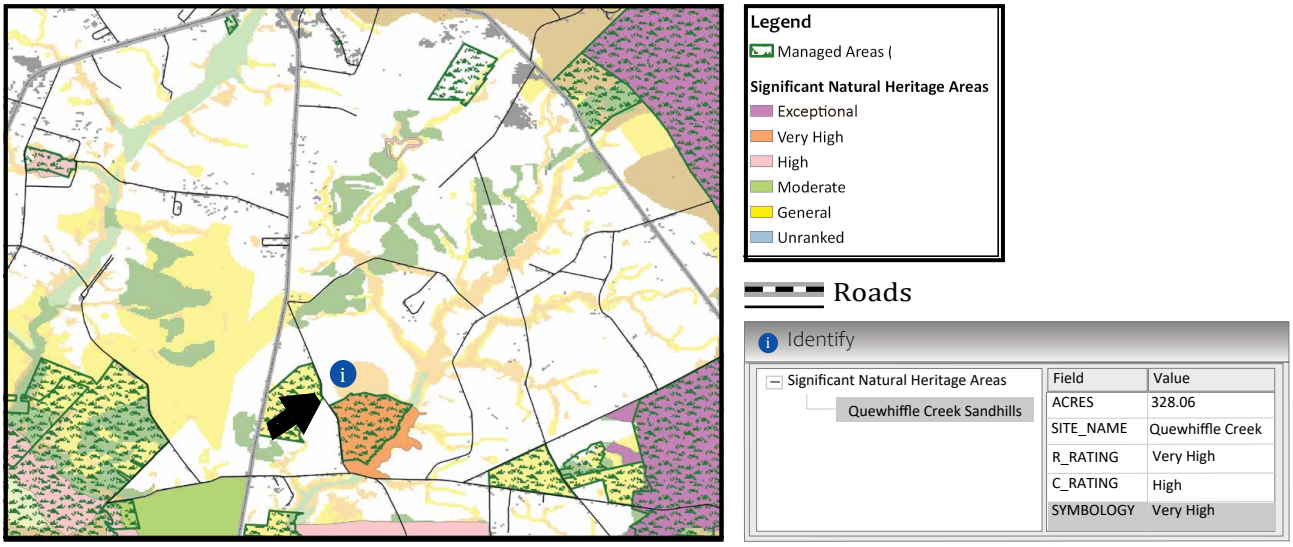
- The rating system for NHAs changed in 2013 to make the evaluation of sites more consistent. Click here for information on the rating system[i]
- Descriptions on Natural Heritage Areas are detailed in County Inventory reports, which can be requested here[j]

Recommended use of these data:

- To identify districts where conservation and connection of natural open space in development standards could be a priority.
- These areas should be set-aside from development as much as possible.
- To identify high priorities for new parks and conservation lands.
- To identify high priority areas where a proportion of the site could be required to be conserved, if habitat is verified by a site survey, or where the placement of required open space should be encouraged.
- To identify high priority routes for wildlife travel corridors.
- When using this data please contact us at greengrowth@ncwildlife.org.

Please note: The BWHA depicts a 300 foot wide area of high conservation value on each side of the waterways classified as *Aquatic* Natural Heritage Areas (see Figure 4).

FIGURE 2. NATURAL HERITAGE AREAS



*** Compare this to Figure 1 to view how NHAs are depicted in the BWHA.**

Under the NHA rating system each NHA has a C and R rating based on the biodiversity and rarity of species on the site (C rating) and the condition of the globally imperilled species populations on the site (R rating). The SYMBOLOGY field offers a single rating for each NHA that is equal to the highest C or R rating.

i https://www.ncnhp.org/conservation/natural-areas
j https://www.ncnhp.org/publications/nhp-publications/searchable-list-nhp-publications

Natural Heritage Element Occurrences

- GIS Shapefile: nheo
- Original Source: NCNHP

Natural Heritage Element Occurrence (NHEO)[k] data identify approximate locations of rare plants and animals, high quality, or unique natural communities), and important animal assemblages (places where rare animals live in groups).

- These plants, animals, natural communities, and animal assemblages are elements of natural diversity and features of conservation interest. The locations where elements have been seen are referred to as element occurrences or "EOs" because they represent where an element occurs on the landscape, either currently or historically.[2]
- The NHEO data includes observations of plants and animal that have legal protection at the federal and/or state level as well as elements that do not have any legal protection but are being monitored by the N.C. Natural Heritage Program (NCNHP). However, not all priority wildlife and habitats species datasets are included.
- Most biologists and ecologists contribute to this dataset so it is fairly comprehensive. Despite this, if the dataset does not show an element occurrence at a location, it does not mean one is not there; the area may never have been surveyed. For this reason, NHEO data alone cannot be used to decide if an element is found at a location or not.
- The NHEO data are very useful for planning purposes because if an element occurrence has been seen in or near an area of interest, then it is more likely to be found in that area if the habitat a plant or animal uses is also present there.

Tier 1 vs. Tier 2 Data File

- The NHEO data is available as either Tier 1 or Tier 2 datasets. The Tier 2 data is only available to federal or state government employees.
- The Tier 1 data contains the same mapped features as shown in the Tier 2 data; however, the identity of data sensitive element occurrences in this data set has been removed to protect them. to get the identity of specific data sensitive records.
- IMPORTANT – The NHEO data has been abused for illegal and damaging collection of rare wildlife and plants. This data set should not be integrated into public online data systems or element occurrence locations labeled with species names on maps.
- Please see the NCNHP's Terms and Conditions of Use[l] for additional details about using NCNHP data.

Accuracy

- These data come from field surveys and some element occurrences may have been destroyed since their most recent survey. Therefore, it is important to verify their existence by an on-the-ground survey of the site.
- NHEO data that are large perfect circles or squares mean that habitat for a species is likely to occur on undeveloped, natural areas within those polygons, but that the exact location has not been determined.
- NHEO data used in the BWHA includes only the most accurate records.

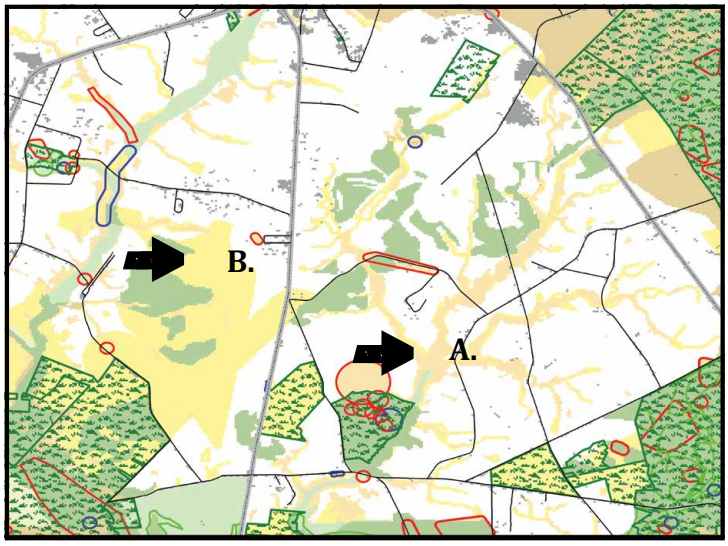
Recommended use of these data:

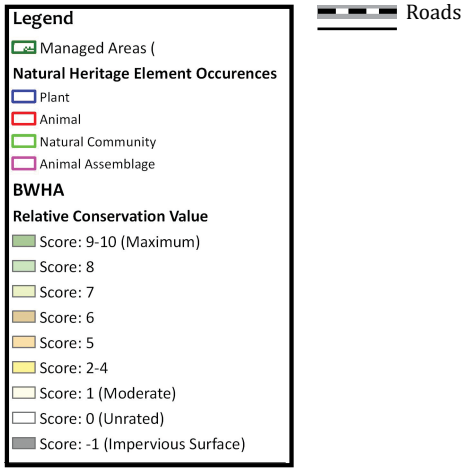
- See recommendations for Natural Heritage Areas.
- NHEO data identifies Colonial Waterbird Nesting Colonies, areas where groups of waterbirds, such as herons and egrets, nest in colonies. We recommend a 330-foot buffer around the colony to prevent birds from abandoning their nests when development occurs in close proximity to the nests.

k https://www.ncnhp.org/conservation/natural-heritage-element-occurrences

l https://ncnhde.natureserve.org/legal

FIGURE 3. NATURAL HERITAGE ELEMENT OCCURRENCES AND GUILDS

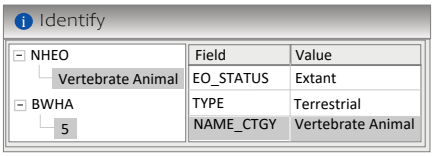




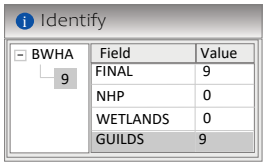
A) Depicts a Natural Heritage Element Occurrence for a rare animal. This area is ranked as a 5 out of 10 in the BWHA.

B) Depicts a habitat that is ranked as a 9 out of 10 in the BWHA because it is a 'Landscape Habitat Indicator Guild' (see below) of a rare and high-quality habitat type.

A.



B.



Landscape Habitat Indicator Guilds

- Interpret from the BWHA
- Original Source: NCNHP

Landscape Habitat Indicator Guild[m] (hereafter "guilds") represent high-quality, core wildlife habitats and connections between those habitats where wildlife can travel. These habitats are mapped based on the presence of guilds (groups) of species that use a particular type of habitat. These species are highly sensitive to habitat fragmentation and need large areas of habitat that are not separated by incompatible vegetation types, development or roads that they cannot travel across. Guild areas are ranked as a higher priority for conservation if they are more rare and if there are records of a larger number of guild species.

Accuracy

Each guild core habitat area is established only when field surveys confirm the presence of guild species within the habitat. The core areas and habitat connectors are then mapped using aerial photos. The extent of the habitat and wildlife travel corridors is based on the documented dispersal behavior of the guild species from the scientific literature.[3]

Recommended use of these data:

- See recommendations for use of the BWHA.
- Interpret the presence of guilds from the BWHA where the data table "GUILDS" field is a value greater than 0.
- If using this data in site design, on-the-ground surveys may be needed.

m https://www.ncnhp.org/activities/inventories/landscape-habitat-guilds

Riparian Habitats and Priority Watersheds

The BWHA depicts buffers on all streams. These recommendations are based on extensive scientific research that demonstrates conditions necessary to conserve aquatic life. We recommend trying to keep impervious surfaces to 10 percent in all watersheds due to the detrimental effects of runoff on aquatic life. We recognize our recommendations may not always be possible and encourage local governments and developers to do as much as possible through development standards, especially in priority watersheds.

Streams within Subwatersheds with Federally Listed Fish and Mussels

- GIS Shapefile: Fed_hucs
- Original Source: NCNHP
- GIS map layer only available on the GGT website.

- Biologists with the NC Wildlife Commission and the U.S. Fish and Wildlife Service conduct field surveys that help identify subsections of watersheds (subwatersheds) that contain federally listed fish and mussels.
- If a federally listed fish or mussel is found within streams in a subwatershed or if the subwatershed leads directly into waters that contain federally threatened or endangered species, the subwatershed will appear in this map layer.[n]

Accuracy
These data are collected during field surveys and the map is updated every six months.

Recommended use of these data:

- All streams in these subwatersheds are recommended to have 200 foot buffers on each side of the stream to ensure the endangered animal's habitat is maintained. This buffer is represented on the BWHA map.
- Aim to keep impervious surfaces to a maximum of 10 percent in watersheds.
- These recommendations come from a scientific literature review and recommendations published by the NC Wildlife Commission. See page 27, "Where can I find more information?" for details.

Map Layers from Other Organizations

Outstanding Resource Waters and High Quality Waters

- GIS Shapefile: hqworw
- Original Source: N.C. Division of Water Resources

- In addition to using data on the location of streams, we recommend local governments use a layer that depicts watersheds that contain streams that are Outstanding Resource Waters and High Quality Waters.[o]
- This map layer was developed by the North Carolina Division of Energy, Mineral, and Land Resources "to protect waters which are rated excellent based on biological and physical/chemical characteristics."[4]
- Streams within these watersheds are important for wildlife habitat and biological diversity because they are high-quality, which means they are likely to support healthy ecosystems.

Accuracy
These waters go through a rigorous process to become designated but are not always taken off of this list once they become impaired and no longer meet the criteria.

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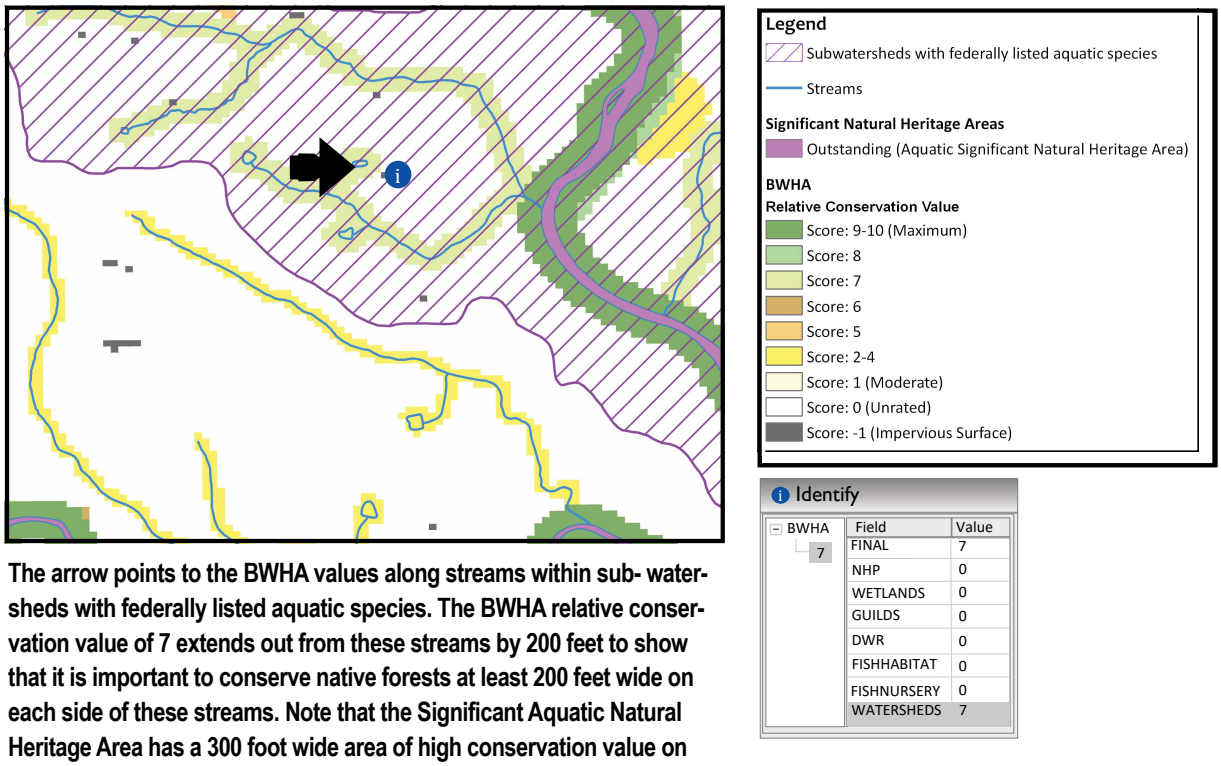
n https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Conservation-Data#96141739-important-watersheds

o https://deq.nc.gov/about/divisions/energy-mineral-land-resources/hqw-orw

FIGURE 4. RIPARIAN HABITATS: SUBWATERSHEDS WITH FEDERALLY LISTED SPECIES



The arrow points to the BWHA values along streams within sub- watersheds with federally listed aquatic species. The BWHA relative conservation value of 7 extends out from these streams by 200 feet to show that it is important to conserve native forests at least 200 feet wide on each side of these streams. Note that the Significant Aquatic Natural Heritage Area has a 300 foot wide area of high conservation value on each side. We recommend conservation of these buffer areas.

Recommended use of these data:

- To identify priority watersheds within which streams or rivers could be buffered by at least 100 feet (or 200 feet if they also contain federally listed species) on each side.
- Aim to keep impervious surfaces to a maximum of 10 percent in watersheds.

Wild Brook Trout Streams (Mountains only)

North Carolina is home to more brook trout than anywhere else in the Southeast, yet this prized fish has been greatly impacted and now exists only in 20 percent of its historic range.

We do not provide these streams as an individual map layer because it is possible to identify the location of these streams from the BWHA map and by using the 'hydro24k' streams map layer (on page 28). These streams are identified in the BWHA data table as FISHHABITAT with a BWHA rank of 9 and have a 100 foot buffer mapped on each side of them.

Recommended use of these data:

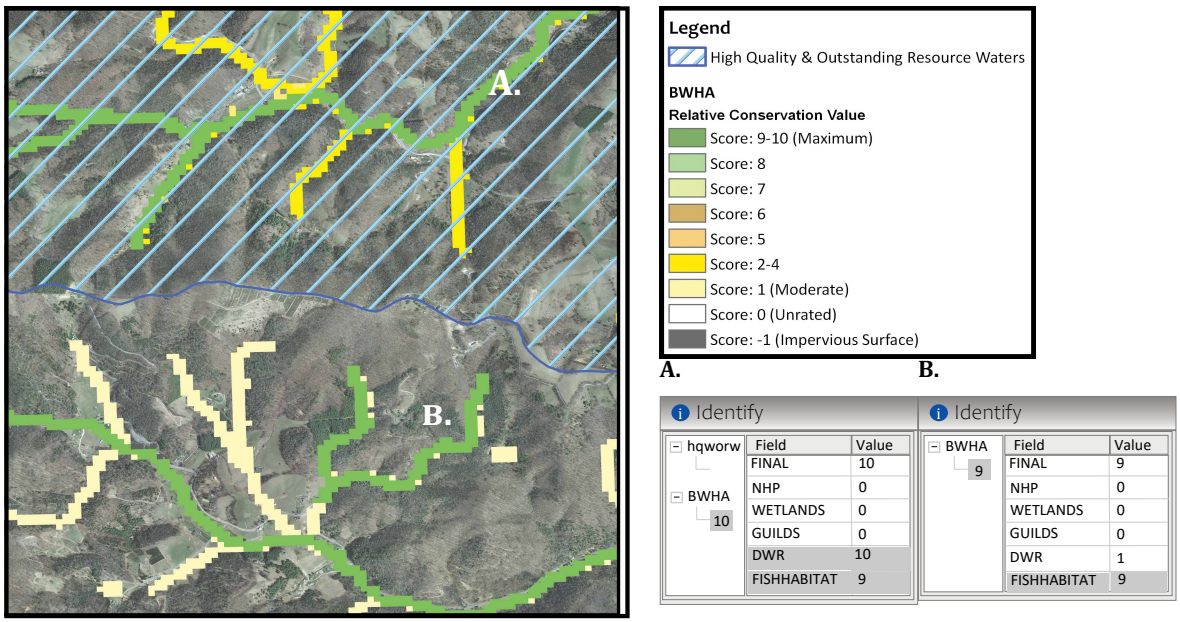
- To identify priority watersheds with streams or rivers that could be buffered by at least 100 feet (or 200 feet if they also contain federally listed species) on each side.

Where can I find more information on aquatic wildlife conservation?

N.C. Wildlife Commission conservation recommendations for aquatic wildlife can be found in Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality.[p]

p https://www.ncwildlife.org/portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf

FIGURE 5. RIPARIAN HABITATS: HIGH QUALITY AND OUTSTANDING RESOURCE WATERS AND WILD TROUT STREAMS



A) The BWHA relative conservation value for this stream is a 10 because the stream is rated as Outstanding Resource Waters by the N.C. Division of Water Resources (DWR). The GIS map layer for High Quality and Outstanding Resource Waters, which is a statewide map is also depicted. The data table shows a value of 9 for FISHHABITAT. This means that the stream also contains wild trout. Wild trout only occur in some streams in the mountains.

B) This stream contains wild trout and is not rated as High Quality and Outstanding Resource Waters therefore the BWHA value at this location is 9 for the FISHHABITAT field and the FINAL field.

Streams

- GIS Shapefile: hydro24k
- Original Source: N.C. Division of Water Resources
- Best GIS data are available for some streams via the N.C. Stream Mapping Project.

- State regulations administered by the N.C. Division of Water Resources (NCDWR)require the use of their data by communities in several river basins. You should consult these regulations,[q] as this handbook is not meant to describe or replace these regulations.
- The best available source of data to identify and classify streams is from the North Carolina Stream Mapping Program[r]. Unfortunately, this dataset is currently only available for certain mountain counties.
- The dataset that is available statewide for streams is the 1*:24,000-scale Hydrography with Water Classifications based on the USGS 1:24,000 scale Topographic Quad Data* (also known as "blue-line" streams).

Accuracy

Research indicates that USGS topographic maps (and USDA Soil Survey maps) are somewhat inaccurate. Due to such inaccuracies, we recommend field surveys be conducted to identify and classify stream location and quality ahead of development.

q https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/stormwater/stormwater-program/stormwater-rules-and-regulations

r https://www.nconemap.gov/pages/streams

Recommended use of these data:

Identify stream location on the ground.

- The 'hydro24k' map layer is most appropriate to use for viewing the general locations of streams. If N.C. Stream Mapping data is not available it is best to survey stream location on site.
- The NCDWR has developed a stream identification manual[s] that presents guidance on identifying intermittent and perennial streams in North Carolina.

Buffer verified streams in order to adequately conserve aquatic life and water quality.

Use the DWR Classifications in the data table to understand the BWHA rank for stream buffers.

- The BWHA ranks stream buffer areas based on the DWR surface waters classification – denoted as the field DWR in the BWHA data table. Refer to Chapter 4 of the N.C. Conservation Planning Tool Report for DWR Classifications and BWHA conservation value ranks.
- In the hydro24k streams map layer data table, refer to the 'CLASS' field for descriptions of the DWR Surface Water Classification.
- Use the BWHA rank to identify priority stream buffers when stream buffers on all streams are not possible.

Where can I find more information?
The NCDWR website provides more information on Surface Water Classifications[t]

Wetlands

Coastal Region Evaluation of Wetland Significance (CREWS)

- GIS Shapefile: [County name]_wets
- Original Source: NCDCM

This dataset contains information on wetland quality and is sometimes more accurate than the National Wetlands Inventory below. The CREWS analysis differentiates between exceptional, substantial, and beneficial wetlands. Exceptional wetlands are the highest quality and the best functioning. The CREWS data provided through the GGT website includes a legend for these wetland significance ratings. Please see the Green Growth Toolbox Coastal Region Appendix and N.C. Division of Coastal Management website for more information.

National Wetland Inventory (NWI) Wetlands

- GIS Shapefile: CONUS_wet_poly
- Original Source: USFWS

NWI Layer—and its Limitations

- The only available GIS layer that displays wetland locations across the state is the National Wetland Inventory[u] layer, which was mostly produced using high altitude aerial photographs from the 1980s and elevation, soils maps, and other information.
- Due to the inaccuracies in photo interpretation and draining and ditching of wetlands over the past decades, this layer is generally considered to have moderate to low accuracy because it does not completely reflect conditions on the ground. In addition, this layer does not have easily accessible wetland quality information.
- We recommend using this layer in planning because the NWI layer is the only available source of wetland data for the entire state.

s https://deq.nc.gov/media/4810/download
t https://deq.nc.gov/about/divisions/water-resources/water-quality-permitting/401-buffer-permitting-branch
u https://www.fws.gov/program/national-wetlands-inventory

Recommended use of these data:

- To identify areas where many wetlands exist and where extensive development may not be appropriate in order to conserve water and wildlife.
- In order to conserve small wetland communities (isolated wetlands fed by surface water and not by streams or rivers) for wildlife and water quality, it is essential that wetlands be surrounded with undisturbed upland habitat. For more information and recommended buffer widths, see Section 3, pages 54 to 56.
- To identify areas to survey for confirmation of wetland presence and habitat quality.

Why are wetlands important for wildlife?

- In addition to playing an important role in cleaning and storing our water, many wetlands provide outstanding wildlife habitat and have high biodiversity.
- The N.C. Wildlife Action Plan identifies wetland communities as priority habitats for conservation efforts across the state.[5]
- Small wetland habitats such as vernal pools, seeps, bogs and small depression ponds are especially important as breeding sites for amphibians and reptiles because they do not typically contain fish that prey on their eggs and young.
- Due to the lack of regulations for protecting small wetlands (typically < 0.1 acre), these are declining dramatically along with the unique animal and plant species that depend on these types of wetlands.

Important Bird Areas (IBAs)

Important Bird Areas[v] are documented and mapped by the N.C. Audubon Society using field survey data. All IBAs rank as a 6 in the BWHA.

- GIS Shapefile: NC_IBAs
- Original Source: N.C. Audubon Society

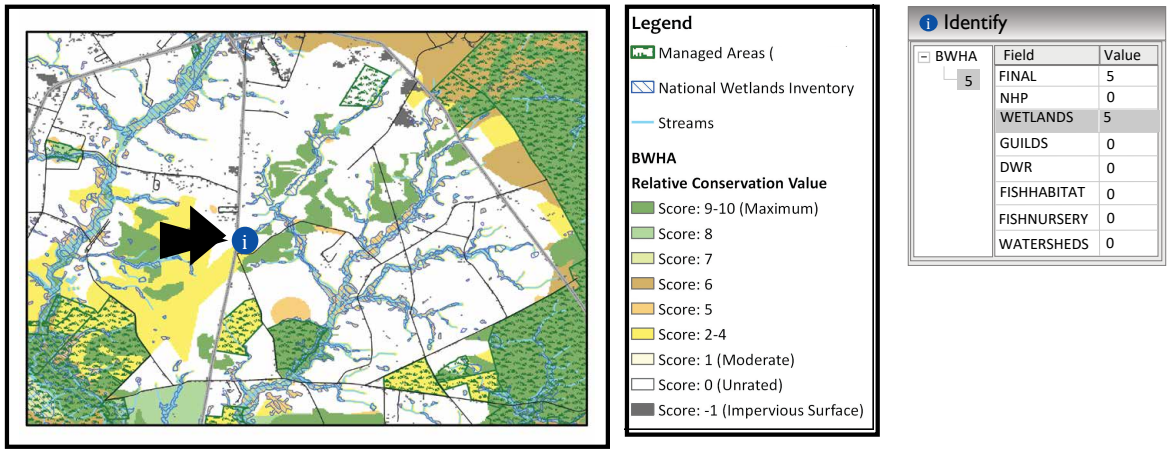
"IBAs, are places that provide essential habitat for one or more species of birds at some time during their annual cycle, including breeding, migration and wintering periods. Well-known North Carolina IBAs include iconic landmarks such as Grandfather Mountain and Cape Lookout National Seashore. Nearly all of the state's IBAs include a state, federal, or nongovernmental conservation lands component, but many also contain a high percentage of privately owned and managed land." [6]

Recommended use of these data:

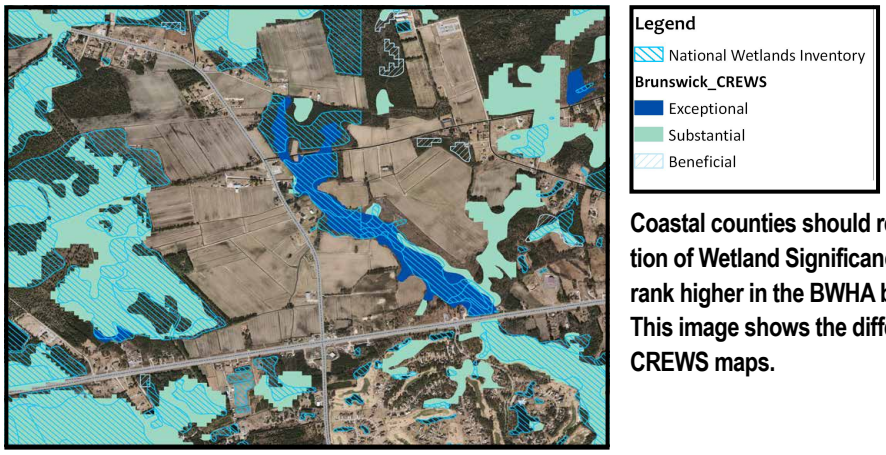
- This data is most appropriate for visioning and plan making because IBAs are typically very large. All areas within the IBAs are important to birds, however, specific habitat that should be conserved within the IBAs is best identified by a biologist or by using the other map layers in the Conservation Data for Green Growth.
- Identification, during visioning and plan making, of areas where large blocks of fields and forests should be maintained.

v https://www.audubon.org/important-bird-areas/state/north-carolina

FIGURE 6. WETLANDS



For non-coastal counties the available wetlands data are from the National Wetlands Inventory (NWI), pictured above. The BWHA 'WETLANDS' value for NWI wetlands is always 5.



Coastal counties should refer to the Coastal Region Evaluation of Wetland Significance—CREWS. CREWS wetlands can rank higher in the BWHA because the data are more accurate. This image shows the differences between the NWI and the CREWS maps.

COMPONENT 2 ▸ Statewide Data to Use in Addition to the Biodiversity and Wildlife Habitat Assessment

Managed Areas

- GIS Shapefile: marea
- Original Source: NCNHP

Managed Areas[w] displays private and public lands that are managed under an agreement, easement, or public ownership where habitat management is one of the goals. Management on these areas can include prescribed burning and tree thinning to enhances wildlife habitat.

- The N.C. Conservation Planning Tool provides a more extensive set of Open Space and Conservation Lands maps that include lands that are not managed for habitat.

Recommended use of these data:

- Buffer and connect these areas with other natural areas by encouraging agricultural districts around and between them. Managed Areas include NC Wildlife Commission Game Lands discussed below.

w See https://www.ncnhp.org/activities/conservation/managed-areas

Why is it important to connect Managed Areas with corridors of undeveloped land? When permanently conserved lands are surrounded by development, many wildlife species and habitats within them will cease to exist. Wildlife and plant populations need to be connected with one another to maintain genetic diversity.

Smoke Awareness Areas

- GIS Shapefile: Smoke_Awareness
- Original Source: NCWRC

Smoke awareness areas demonstrate locations that are most likely to experience smoke from prescribed burning. See page 4 for information on prescribed burning. These areas are indicated by a one half mile boundary drawn around the perimeter of lands managed with fire. The Sandhills GGT Regional Appendix has more refined Smoke Awareness Area maps based on local conditions. Most prescribed burns occur on smaller units within larger tracts of managed lands. Agencies and organizations that conduct prescribed burns do so only under conditions that are designed to maximize vertical smoke dispersal and minimize any impacts to public safety. See Section 5, page 104, for information on Wildfire and Smoke Management ordinances.

Recommended use of these data:

- To identify areas where working lands or natural areas should be encouraged to avoid the exposure of residents to smoke for a few days every two to three years.

Game Land Hunting Safety Buffers

- GIS Shapefile: gml_buffer
- Original Source: NCWRC

- Conflicts can arise between Game Land users and residents who live close to Game Lands, such as disturbance to homeowners and limits to hunting on Game Lands. To minimize such conflicts, we recommend establishing a 150 yard hunting safety buffer[x] around Game Lands in your jurisdiction, especially in areas where Game Lands are narrow.
- The hunting safety buffer map layer displays this recommended 150 yard buffer.

Recommended use of these data:

- To identify areas where working lands or natural areas should be encouraged to maintain habitat quality and connectivity and the use of Game Lands for hunting.

Bald Eagle Nest Buffers

- GIS Shapefile: Contact NCWRC for data
- Original Source: NCWRC

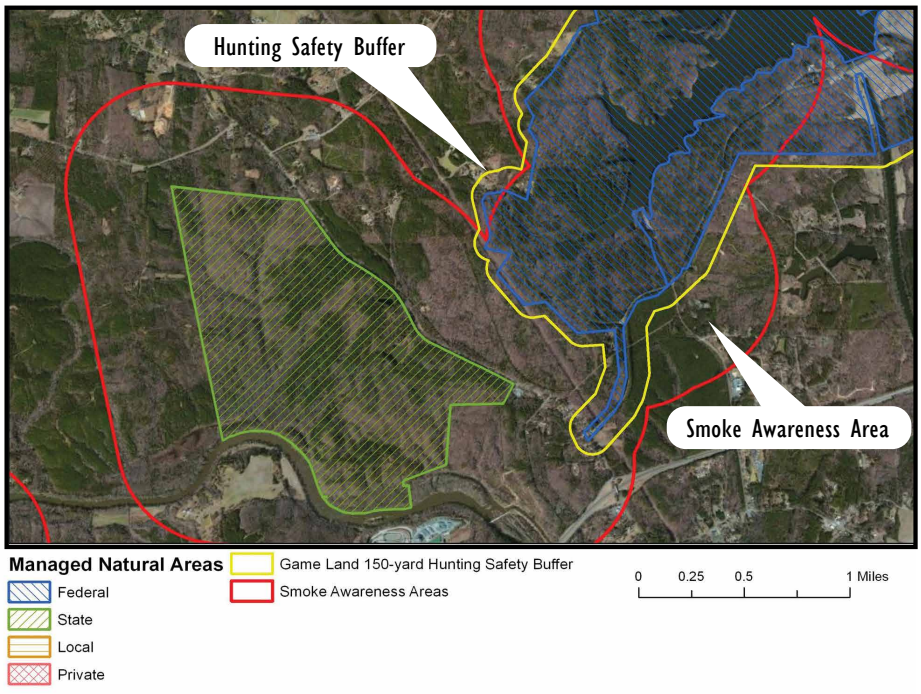
Bald eagles are protected under the Bald and Golden Eagle Protection Act. This map layer displays a 330 and a 660-foot buffer on each nest.

Recommended use of these data:

- To identify areas for a 330 or 660-foot no-touch buffer that will protect bald eagles. A 660-foot buffer is needed if development is visible from the nest.
- We recommend consulting with the U.S. Fish and Wildlife Service. See Appendix B for contact information.

x https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Conservation-Data#96141741-hunting-safety--smoke-awareness-areas

FIGURE 7. MANAGED AREAS, SMOKE AWARENESS AND HUNTING SAFETY AREAS



Managed Areas are privately or publically owned and are managed for wildlife and biodiversity conservation to some extent under a conservation agreement. These areas appear in hatched colors above. The managed areas where prescribed fire takes place have a smoke awareness area mapped around them. NCWRC Game Lands have a hunting safety buffer of 150 yards mapped around them. It is important to encourage working lands around and between Managed Areas to maintain habitat quality and wildlife travel corridors.

Floodplain Boundaries from the N.C. Floodplain Mapping Program

- N.C. Floodplain Mapping Program data maps the 100 and 500-year floodplains.
- In addition to using floodplain data to reduce flood hazards, data on flood plains can help local governments plan to conserve this valuable wildlife habitat.

- Original Source: NC Floodplain Mapping Program
- Download from their website at www.ncfloodmaps.com

- To download the best available data floodplain data for your county, visit N.C. Floodplain Mapping Program[y]

Recommended use of these data:

- Displaying floodplain boundaries can provide a starting place for identifying important floodplain forest habitats within floodplain boundaries either with aerial photos or on the ground surveys.
- Consider discouraging major development in the 100 or 500-year floodplains. One hundred-year floods (one percent chance of annual flooding) are more common due to climate change. Property damage can be reduced by conserving habitats for wildlife and plant communities by not building in floodplains.

y https://flood.nc.gov/ncflood/mappingprogram.html

Other Assessments in the N.C. Conservation Planning Tool

Besides the Biodiversity and Wildlife Habitat Assessment, the CPT includes other natural resource assessments.[z] Detailed information on the map layers is provided in the CPT report.[aa]

- Open Space and Conservation Lands[ab] by the N.C. Natural Heritage Program
- Agricultural Lands Assessment[ac] by the N.C. Department of Agriculture & Consumer Services
- Forest Lands Assessment[ad] by the N.C. Forest Service based on the N.C. Forest Action Plan.[ae]

Recommended use of these data:

- To identify areas where multiple natural resources and wildlife conservation objectives can be achieved through maintaining agricultural districts, connected wildlife habitat, and working lands

Additional Mapping Resources for Resiliency Planning

Wildlife habitats provide important services for helping our communities become more resilient to a changing climate. The protection of floodplains and wetlands will help reduce hazards associated with extreme storm events, the protection of tree canopy in our developed landscapes will reduce hazards associated with higher temperatures, and natural areas sequester and store carbon, reducing our greenhouse gas footprint. See Section 1 for more information. The N.C. Office of Climate Resiliency and Recovery provides a centralized place[af] for acessing data related to climate resiliency planning needs. The datasets most applicable to wildlife conservation planning are highlighted below.

Resilient and Connected Landscapes

With climate change, the impacts of a fragmented landscape on wildlife are compounded, as wildlife need to move across the landscape in response to ecosystems that are shifting geographically as the climate shifts. For example, as temperatures increase, some species that thrive in cooler temperatures will shift their range northerly to follow those cooler temperatures. The Nature Conservancy's Resilient and Connected Landscapes dataset[ag] is a useful dataset for understanding which habitats are most important to conserve to support ecological shifts in our landscape. There are two assessments available that are useful for land use planning work:

1. Resilient Sites: these are areas on the landscape that are the most resilient to climate change because they are well connected across the landscape and contain a variety of habitats within them, which allows terrestrial wildlife to respond to shifting habitats easily and allows them to move in response to extreme weather events.
2. Connectivity and Climate Flow: This assessment identifies areas that have more and less ability for terrestrial wildlife to gradually move in response to changes in the climate. Areas that have many barriers are not easy for wildlife to move through show up in brown colors; blue areas are more connected natural areas that faciliate wildlife movement.[7]

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z ttps://ncnhde.natureserve.org/content/datadownload
aa http://ncnhp.org/conservation/conservation-planning-tool/resources/report
ab https://www.ncnhp.org/documents/open-space-and-conservation-lands
ac www.ncmhtd.com/EnvironmentalPrograms/AgAssessment/
ad www.ncmhtd.com/NCFS/ForestActionPlanPriorityLayers/
ae www.ncforestactionplan.com
af https://www.rebuild.nc.gov/resiliency/climate-data
ag http://www.conservationgateway.org/ConservationPractices/ClimateChange/Pages/Climate-Resilience.aspx

Recommended use of these Data:

- When used in addition to the BWHA, Marea, and other Component 1 Conservation Data, this data can be used to idenitfy where communities might prioritize protection. Consider conserving the 'more' and 'most' resilient sites where possible and ensure that that a network of wildlife corridors and habitat patches are conserved to the extent possible within lesser resilient areas.
- The Connectivity and Climate Flow dataset could be used in transportation planning to identify where roads are intersecting areas of high flow; these can then be considered for providing improved wildlife passage infrastructure.
- At a fine scale, the boundaries of these layers may be inaccurate. They are useful for planning but they are not appropriate for development review and site design.

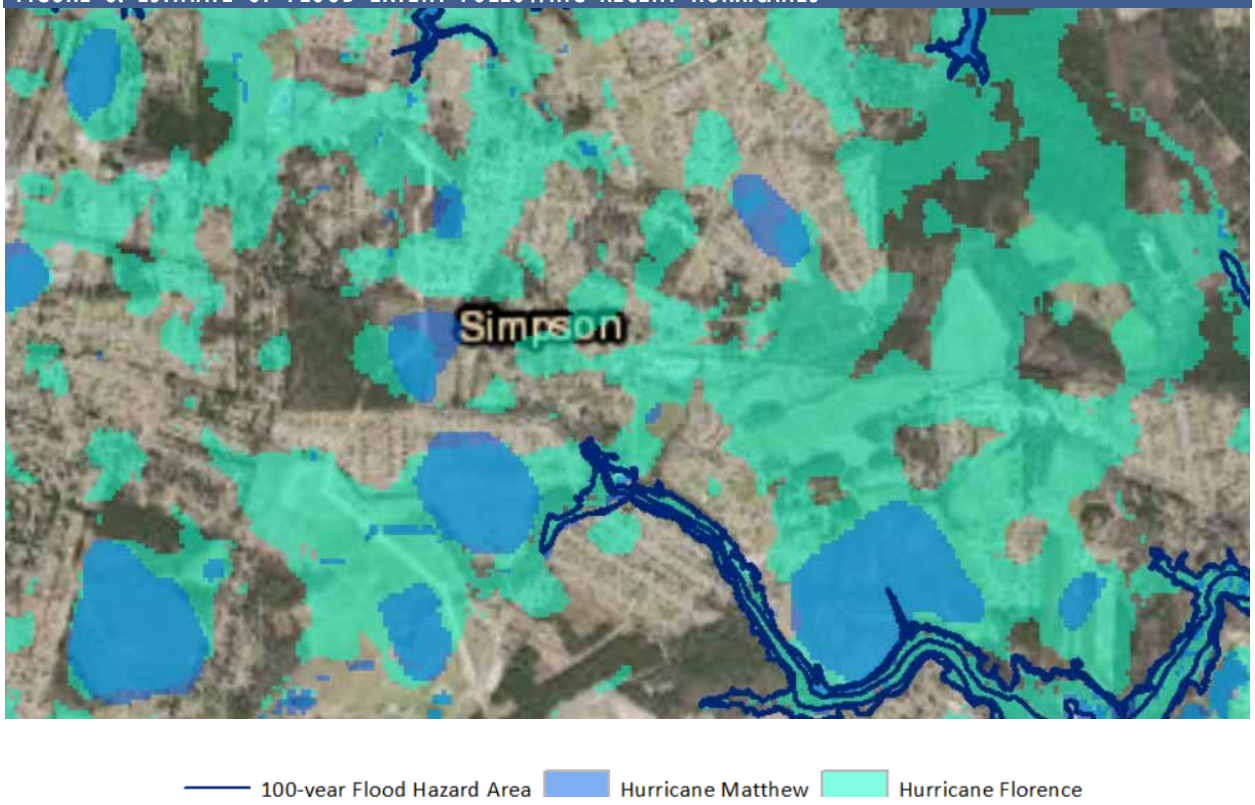
Estimate of Flood Extent following Recent Hurricanes

TNC used satellite imagery to map the estimated inland flood extent of recent hurricanes (Hurricanes Matthew, 2016 and Florence, 2018). Their analysis shows that flooding often went beyond the 100-year floodplain boundaries (figure 8).[8]

Recommended use of the Data:

- Use this data to understand where flooding may occur in future storm events.
- Consider discouraging development in areas that may experience flooding.
- Target these areas for conservation easements and acquisitions, buy-outs, and habitat restoration.

FIGURE 8. ESTIMATE OF FLOOD EXTENT FOLLOWING RECENT HURRICANES



Recent hurricanes led to historic levels of flooding. The Estimate of Flood Extent dataset helps communities prepare for emergencies, understand flood risks to developed land uses, and plan to reduce impacts by reducing development in areas that may flood.

NC Conservation Benefits Calculator

The NC Conservation Benefits Calculator[ah] is a web-based tool developed by Duke University's Nicholas Institute for Energy, Environment & Sustainability in collaboration with the Conservation Trust for North Carolina to help decision-makers understand the multiple benefits natural and working lands provide to communities and/or landowners. Many of these benefits match resiliency-related goals a community might identify. The tool can calculate a range of metrics related to different benefits a community or landowner gains when protecting an area of interest. This tool can help decision-makers understand the value of protecting certain properties from development. It can also help communities track progress towards meeting goals identified in a plan.

- Carbon storage and sequestration metrics show how much carbon is currently stored in forested areas in your community and show the potential of areas to store carbon into the future (sequestration). This helps communities understand how forested areas meet resiliency goals of reduced greenhouse gas emissions.
- The downstream flood attenuation metric helps communities understand what areas will reduce flooding, if protected from development, and can be used to support hazard mitigation planning.
- The wild pollination metric can be used to identify habitats that can be conserved to protect wild pollinator species that pollinate crops in agricultural areas.
- Another tool, the Conservation Prioritization tool[ai], looks at the range of benefits at a watershed scale (HUC-12) and helps users understand which watersheds land conservation work will provide the most benefits. This information may help communities make decisions related to zoning and future land use.

The User's Guide[aj] provides information on how to use the tools, the methods behind the development of the metrics, and the sources for the different data sets, which include data from the NHP and TNC. See the Nicholas Institute website[ak] for more information.

Many other natural resources datasets are availlable to support climate resiliency on the coast and are described in the Coastal Regional Appendix.

Further References for Conservation Planning

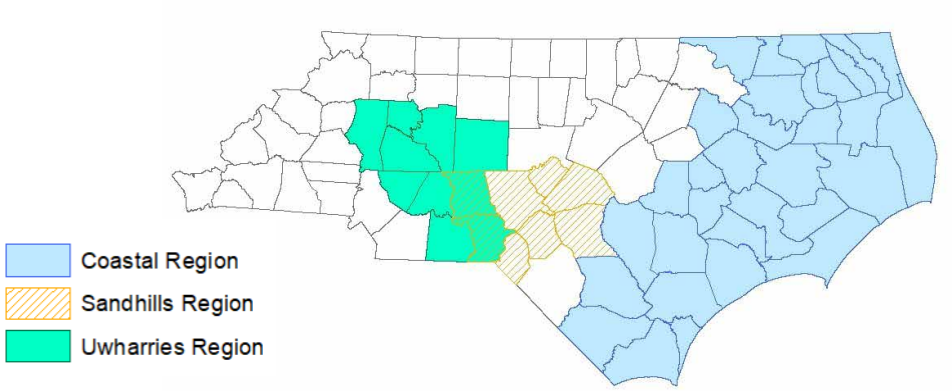
There are a variety of resources that can be used to identify priority areas to employ conservation-based development planning methods. The number of map layers and the scale of the tools below make them most appropriate for reference to identify priority conservation areas during planning as opposed to being part of the core set of Conservation Data for Green Growth map layers. See Appendix F for details.

- The Southeast Conservation Blueprint[al] - crafted by the Southeast Conservation Adaptation Strategy, identifies priority areas and habitat types and estimates habitat quality.[9]
- Conservation Opportunity Areas[am] - identifies watersheds that have the most need for conservation due to the likely occurrence of species of greatest need on unprotected lands.[10]

ah https://prioritizationcobenefitstool.users.earthengine.app/view/cobenefitscalculator
ai https://prioritizationcobenefitstool.users.earthengine.app/view/nc-huc-12-conservation-prioritizer
aj https://storymaps.arcgis.com/stories/6ac20916c67b4164901b50ac3e640d6a
ak https://nicholasinstitute.duke.edu/project/conservation-planning-tools-north-carolinas-people-and-nature
al https://secassoutheast.org/blueprint
am http://tecumseh.zo.ncsu.edu/coa/

In addition to data that are relevant statewide, more detailed conservtion data exist for different regions of the state, see figure 9 below. These are are explained along with regional habitat information in the Regional Appendices.[an] We recommend that mountain counties use the Southern Appalachain Man and the Biosphere[ao] Conservation Data.

FIGURE 9. REGIONAL APPENDICES



USING CONSERVATION DATA IN LOCAL PLANNING

Local governments can take four basic steps to start using the Conservation Data for Green Growth in planning activities:

1) **Integrate the data with your community's online or networked GIS database.**
2) **Use the data in visioning and plan making.**
3) **Use the data in incentives and ordinance and rule setting.**
4) **Use the data in development site location, review and design.**

1. Integrate the dataset with your community's GIS database.

The most effective way to use this dataset is to integrate it with your community's existing GIS database and online interactive map server.

- These layers can then be easily accessed by developers for site selection, all local government departments, and the public during planning projects.
- Prevent illegal collection of rare species by displaying only the public Natural Heritage Element Occurrence data without species names on public maps.

Example

- Chatham County, NC's Conservation Viewer[ap]

Update Data Regularly

It is important to schedule regular updates of your community's Conservation Data. If you link to the ARCGIS Map Services directory, the data on your website will be updated as the original source is updated. Datasets available for download on the Green Growth website will be updated once per year. It is best if you schedule updates for different layers from their original source using information provided in the quick reference guide on page 42.

an https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Conservation-Data/Regional-Data
ao https://www.samab.org/
ap https://chathamncgis.maps.arcgis.com/apps/webappviewer/index.html?id=50e45ef5a0394cb48dfe81aabccd902a

2. Use the dataset in visioning and plan making

Green planning refers to creating and revising planning documents and stand-alone conservation plans to consider, encourage and enable conservation of priority habitats. For more detailed information, see Section 4 , "Green Planning."

To integrate the Conservation Data for Green Growth in visioning and plan making follow these steps:

1) Display the map layers in planning documents and provide descriptions of what each layer means.
2) Develop strategies to conserve and connect the important species, habitats and ecosystems displayed on maps. A menu of conservation strategies is presented in Section 4.
3) Identify natural areas that may contain important wildlife habitats that have not been mapped such as springs, seeps and vernal pools. Establish goals and strategies to gather this information.

3. Use the dataset in incentives and ordinance and rule-setting.

For more detailed information, see Section 5, "Greening Ordinances."

Greening incentives, ordinances and rule setting involves creating and revising land use incentives and regulations to implement the goals and strategies for habitat conservation set forth in planning documents.

To use the Conservation Data for Green Growth in ordinance and rule setting:

1) Display the map layers on parcel maps and use these maps to help guide development of incentives, placement of zoning districts or subdivision ordinances that encourage open space conservation.
2) Integrate requirements for using the data in relevant parts of your subdivision ordinance. For instance, require development proposals to display conservation data map layers on development plans to help guide voluntary conservation.

4. Use the dataset in development site location, review and design.

For more detailed information, see Section 6, "Greening Development Site Location, Review, and Design."

To "green" developments planners and local government staff can follow three basic steps:

1) Consult the Conservation Data for Green Growth to see if any map layers overlap with the parcels to be developed.
2) Highlight any overlapping habitat areas on preliminary development sketch plans and bring these areas to the applicant's attention.
3) Help the applicant incorporate wildlife friendly development practices into their preliminary plans using the recommendations in Section 3.

Caveats:

* Please note it is not appropriate to require conservation of natural areas solely based on map boundaries. Site surveys are needed to verify habitat presence ahead of development design when specific habitats are required to be conserved.
* It is appropriate to use maps to guide which *districts* require open space set asides. If site surveys before development are not a desired requirement, it is appropriate to encourage (but not to require) that the specific location of natural open space be within mapped habitats.

* It is appropriate to require some form of open space conservation within the boundaries of the game land hunting safety buffers and other map layers based on property boundaries if desired.

NATURAL RESOURCE INVENTORIES AND SITE SURVEYS

A natural resource inventory or a site survey involves biologists and ecologists doing fieldwork to collect information about the location and status (condition or rarity) of important species and habitats. The Conservation Data for Green Growth may not always provide all of the information your community may need to understand the condition of local natural assets. Although using Conservation Data is a good starting point, you may wish to do a more extensive field inventory to supplement existing information.

Natural Resource Inventories—Where to start
The following five steps will help you get started.

Step 1. Determine if your county or city needs additional natural resource information.

- First, identify what field inventory work has already been done in your jurisdiction.
- The N.C. Natural Heritage Program has conducted "Natural Heritage Inventories" for many counties across the state. Check here[aq] to determine whether an inventory has been completed for your county. Even if a Natural Heritage Inventory has been conducted recently, you may want additional information—whether for a specific watershed or your entire jurisdiction.

Step 2. Identify how the inventory will be used. You could use the inventory to:

- Better guide transportation and hazard planning,
- Develop conservation strategies for your comprehensive plan,
- Update outdated inventories,
- Improve information to be more competitive for land acquisition grants for natural parks and historic sites,
- Identify important districts or sites for conservation subdivisions,
- Improve management of parks, open space, trails and greenways.

Step 3. Develop a list of the types of natural resources to be inventoried. A qualified biologist can assist in developing this list, which may include:

- Streams, wetlands, springs, seeps,
- High-quality and rare natural communities,
- Important wildlife habitats identified in the N.C. Wildlife Action Plan,
- Significant or sensitive native plant communities,
- Forest resources, including canopy cover, native forest communities, and plantations,
- Location of invasive, exotic species outbreaks.

aq https://www.ncnhp.org/activities/inventories/county-natural-areas-inventory-program

Step 4. Identify how the inventory will be completed.

- An ecological consultant could be hired to complete the inventory.
- Refer to Appendix B for contact information of partner agencies and organizations who may be able to assist your community to complete the inventory at lower expense.
- Work with a biologist to organize a "Bioblitz" as part of your inventory. These are fun events where families, school groups and ecological experts team up to inventory every area possible within 24 hours.
- Whatever your approach, be certain to involve organizations with biological expertise to ensure the inventory methodology is sound.

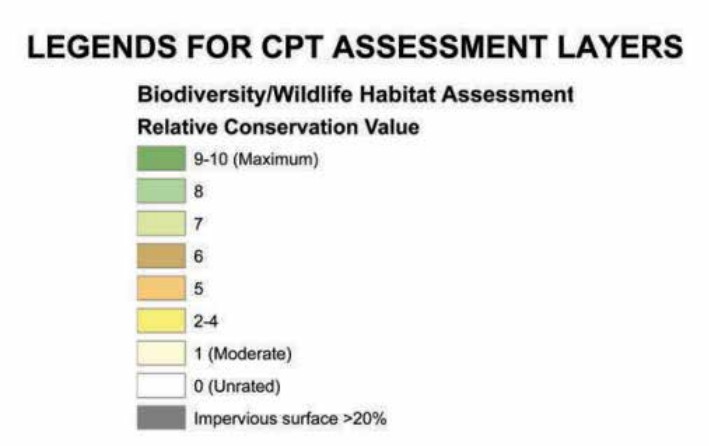
Step 5. Conduct the inventory, analyze the data and develop your product.

- Qualified natural resource professionals should lead the inventory and data analysis efforts.
- One of the most useful products can be a database containing the inventory results.
- Maps displaying the inventory and other Conservation Data can then be used in all of your community's planning activities.

Examples of Local Natural Resource Inventories

- Mecklenburg County, North Carolina, Natural Resources Section[ar] conducts biological inventories to guide park management and purchase.
- Orange County, North Carolina actively updates and uses their Natural Heritage Inventory in their comprehensive plan and in their Natural and Cultural Resources Conservation programs.
- Wake County, North Carolina, Parks, Recreation and Open Space Department con duct natural resources inventories for their parks and work to dedicate nature preserves in partnership with the Wake Nature Preserves Partnership.[as]
- The City of Portland, Oregon, Natural Resource Inventory[at] uses aerial photography and GIS to map important buffers, habitats, and wildlife travel corridors.
- The City of Lakeland, Tennessee, conducts a Natural Resources Assessment used in their Comprehensive Plan.
- Dutchess County, NY, has an award winning Natural Resources Inventory[au] used in land use decision making.

ar https://www.mecknc.gov/ParkandRec/StewardshipServices/NaturalResources/Pages/default.aspx
as https://wakenature.wordpress.com/wakenature-preserves/
at https://www.portland.gov/bps/planning/comp-plan/2035-comprehensive-plan-and-supporting-documents#!/action=viewmore&type=topPages
au https://www.dutchessny.gov/Departments/Planning/Natural-Resource-Inventory.htm



Legend for the Biodiversity/Wildlife Habitat Assessment

Key to Identify Tool Results for the Biodiversity/Wildlife Habitat Assessment			
Category Name	**Value**	**Individual Input Layers**	**Source for Input Layers**
NHP	10	Natural Areas – Exceptional and Very High Site Rating	*N.C. Natural Heritage Program*
	8	Natural Areas – High and Moderate Site Rating	
	6	Natural Areas - General Site Rating	
	5	Element Occurrences – High ranking	
	4	Element Occurrences – Other	
Wetlands	7	Coastal Region Evaluation of Wetland Significance (CREWS) – Exceptional	*N.C. Division of Coastal Management*
	6	Coastal Region Evaluation of Wetland Significance (CREWS) – Substantial	
	5	National Wetland Inventory (NWI)	*U.S. Fish and Wildlife Service*
	2	Coastal Region Evaluation of Wetland Significance (CREWS) – Beneficial	*N.C. Division of Coastal Management*
Guilds	1-10	Landscape Habitat Indicator Guilds	*N.C. Natural Heritage Program*
DWR	10	Outstanding Resource Waters	*N.C. Division of Water Resources*
	9	Stream BioClassification – Excellent	
	8	High Quality Waters	
	7	Stream BioClassification – Good	
	1	All other streams	
Fish Habitat	9	Wild Brook Trout	*N.C. Wildlife Resources Commission*
	8	Anadromous Fish Spawning Areas	*N.C. Division of Marine Fisheries*
Fish Nursery	8	Fish Nursery Areas	*N.C. Division of Marine Fisheries*
Watersheds	7	Stream buffer tributaries to federally-listed species (Threatened & Endangered)	*N.C. Natural Heritage Program*
	3	Priority Watersheds	*N.C. Natural Heritage Program, N.C. Wildlife Resources Commission*
Marine	8	Oyster Sanctuaries	*N.C. Division of Marine Fisheries*
	6	Submerged Aquatic Vegetation (SAV)	
Hardbottom	8	Open Shellfish/Shellbottom	*N.C. Division of Marine Fisheries*
	7	Hard Bottom	
	5	Closed Shellfish/Shellbottom	
IBA	6	Important Bird Areas	*Audubon Society*
Impervious	-1	Impervious Surface above 20%	*U.S. Environmental Protection Agency*

Source: https://www.ncnhp.org/cpt-report-2018

STATEWIDE GIS CONSERVATION DATA REFERENCE CHART

These Conservation Data map layers are the most applicable data available statewide for land use planning. The 'Levels of Planning' column denotes whether the map layer is appropriate for use in the planning activity. Additional regional datasets are referenced in the regional appendices.

REFERENCE INFORMATION[11]					LEVELS OF PLANNING[12]		
GIS Data Layer	**Layer Label**	**Where to Download Directly**	**Update Frequency**	**Summary of Interpretation & Recommendations for use[13]**	**Visioning & Plan-Making**	**Ordinance & Rule-Setting**	**Development Review & Design**
Biodiversity and Wildlife Habitat Assessment	bwha	N.C. Conservation Planning Tool[14] or via N.C. One Map[15]	Biannual	• To identify priority areas for conservation • To identify wildlife and habitat corridors that connect important natural areas • Areas that rank 10 to 7 or 6 should receive the strongest protections. • Low intensity land uses should be encouraged.	X	X	
Map Layers that were used to create the Biodiversity and Wildlife Habitat Assessment - *The map layers below were used to create the BWHA. They can be used for a higher degree of accuracy, more detailed information and to highlight specific types of habitat and priority areas in land use planning activities.*							
Landscape Habitat Indicator Guilds	N/A	Interpret these areas directly from the BWHA data table.	Biannual	(Same as those for BWHA above). These represent large habitats where area sensitive species have been found.	X	X	
Tier 1 Resources: Sensitive Wildlife Habitats - *The map layers below are used in the BWHA and represent the following: a) data of high accuracy that should be ground-truthed at the site level, b) areas that are highly sensitive to development and should be set aside from development to the maximum extent possible.*							
Natural Heritage Areas	nha	N.C. One Map	Quarterly	Field-delineated high-quality habitats that should receive the highest protections.	X	X	X
Natural Heritage Element Occurrences[16]	nheo	N.C. Natural Heritage Program	Quarterly .	(Same as NHA above)	X	X	X
Streams	hydro24k	N.C. One Map	Irregular	Maintain buffer of natural forest at least 100 feet wide, especially in priority watersheds.	X	X	X
Subwatersheds with federally listed fish and mussels	Fed_HUCs	Green Growth Toolbox website[17]	Biannual	Buffer streams within these watersheds by 200 ft to protect imperilled species.	X	X	X
Wild Brook Trout Streams	N/A	Interpret these areas directly from the BWHA data table.	Biannual	The 100 foot stream buffers mapped in the BWHA are a high priority (9 out of 10).	X	X	X
CREWS Wetlands (Coastal counties only)	[County name]_wets	Division of Coastal Management. Obtain from the Green Growth Toolbox website for easier to use legend.	Irregular	• Sites where a federal or state wetlands permit is likely required. • Verify wetlands by survey ahead of development. • Set aside development especially for higher quality wetlands. • Buffer and connect verified wetlands to each other and streams	X	X	
National Wetland Inventory wetlands	CONUS_wet_poly	U.S. Fish & Wildlife Service website[18]	Irregular		X		

STATEWIDE GIS CONSERVATION DATA REFERENCE CHART

REFERENCE INFORMATION					LEVELS OF PLANNING		
GIS Data Layer	**Layer Label**	**Where to Download Directly**	**Update Frequency**	**Summary of Interpretation & Recommendations for use**	**Visioning & Plan-Making**	**Ordinance & Rule-Setting**	**Development Review & Design**
Tier 2 Resources: Wildlife Habitat Landscapes - *The map layers below represent the following: a) data that are meant to be used at large scales and b) areas where agricultural districts should be encouraged and c) areas where low overall development density is recommended but rural cluster development is encouraged outside of sensitive areas and away from Managed Areas.*							
High Quality & and Outstanding Resource Waters	hqworw	N.C. One Map	Irregular	Streams documented to be high-quality and support important resources These are a priority for wide buffers.			
Important Bird Areas (IBAs)	NC_IBAs	N.C. Audubon Society http:// ncaudubonblog.org/downloads/	Irregular	To identify areas where widespread or intense development will negatively impact priority bird species and should be avoided if possible.	X	X	
Map layers not used in the BWHA that we recommend should be used in addition to the BWHA *These layers will give a more complete picture of wildlife habitat conservation needs and opportunities in your community.*							
Managed Areas	marea	N.C. Natural Heritage Program	Quarterly	Buffer and connect these areas with other managed and high priority areas by encouraging agricultural land uses around and between them	X	X	X
Tier 1 Resources: Sensitive Wildlife Habitats							
Colonial waterbird nest site buffers	nheo	N.C. Natural Heritage Program	Quarterly	Maintain a 330 foot undeveloped buffer to avoid disturbing large groups of nests.	X	X	X
Bald Eagle nests	N/A	Obtain from the N.C. Wildlife Resources Commission and filter the detailed NHEO dataset.	Irregular	A formal or informal permit may be needed from the U.S. Fish & Wildlife Service. Buffers range from approximately 330 to 660 feet.[19]	X	X	X
Floodplain boundaries	fldmaphazar	N.C. Floodplain Mapping Program www.ncfloodmaps.com[20]	Irregular	Locations with flooding risk and high potential for important wildlife habitats. Should be set aside from development to the maximum extent possible.	X	X	X
Tier 2 Resources: Wildlife Habitat Landscapes							
Smoke Awareness Areas (approx. ½ mile)	smoke awareness	Green Growth Toolbox website	Yearly	An area that may experience smoke from controlled burning periodically, where it is best to encourage non-developed land uses	X	X	X
Game Land Hunting Safety Buffer (150 yards)	gml_buffer	Green Growth Toolbox website	Yearly	An area where it is best to encourage non-developed land uses to prevent conflicts between hunting and private property	X	X	X
Forestry Lands Assessment		N.C. Conservation Planning Tool	Irregular	Encourage agricultural districts especially in high priority areas	X	X	
Agriculture Lands Assessment					X	X	

1 N.C. Natural Heritage Program. (n.d.). Natural Areas. Retrieved July 2022, from N.C. Natural Heritage Program: https://www.ncnhp.org/conservation/natural-areas
N.C. Natural Heritage Program. (n.d.). Request Copy of an NHP Publication. Retrieved from N.C. Natural Heritage Program: https://www.ncnhp.org/publications/request-copy-nhp-publication

2 N.C. Natural Heritage Program. (n.d.). Natural Heritage Element Occurrences. Retrieved July 2022, from N.C. Natural Heritage Program: https://www.ncnhp.org/conservation/natural-heritage-element-occurrences

3 N.C. Natural Heritage Program. (n.d.). Landscape Habitat Guilds. Retrieved July 2022, from https://www.ncnhp.org/activities/inventories/landscape-habitat-guilds

4 N.C. Department of Environmental Quality - Division of Water Resources High Quality Waters. (2016). Retrieved May 2022, from: https://ncdenr.maps.arcgis.com/home/item.html?id=dc3069c051d54efaaacc8ff837475c3c

5 N.C. Wildlife Resources Commission. (2015). North Carolina Wildlife Action Plan. pp. 311-383.

6 National Audubon Society. (n.d.). Important Bird Areas in NC. Retrieved 2022, from: https://nc.audubon.org/iba

7 The Nature Conservancy. (2021). Resilient Coastal Sites - South Atlantic. Retrieved July 2022, from U.S. Southeast Coastal Resilience: https://www.arcgis.com/home/webmap/viewetml?webmap=22cf8ad5efd5473e819d17adf0216271&extent=-92.4921,21.5104,-60.0385,37.8194

8 Schaffer-Smith, D. (2020). Hurricanes Matthew and Florence: impacts and opportunities to improve floodplain management - GIS Data. Retrieved May 2022, from:https://knb.ecoinformatics.org/view/doi%3A10.5063%2FF1JM280P

9 Southeast Conservation Adaptation Strategy (SECAS). 2021. South Atlantic Blueprint 2021. Retrieved July 2022, from https://blueprint.geoplatform.gov/southatlantic/

10 N.C. Wildlife Resources Commission & Biodiversity and Spatial Information Center. (n.d.). North Carolina Wildlife Habitat Threat Data Viewer and Analysis Tool. Retrieved from http://tecumseh.zo.ncsu.edu/coa/

11 The columns under the header “Reference Information” mean the following: the “GIS Data Layer” column presents the name of each data layer that is described in Section 2 of this handbook, the column titled “Layer Label” displays the name of the shapefile, the “Where to Download Directly” column contains instructions on where to download the most up-to-date data from the original source, and the “Update Frequency” column indicates how often updates are made by the data originator and should be made to each data layer.

12 The columns under the header “Levels of Planning” contain “X” marks that show which levels of planning are appropriate for each data layer. For example, all three boxes in Natural Heritage Areas row are marked with an “X.” This means that this data layer should be used in visioning and plan making, ordinance and rule setting, and development review. On the other hand, only one box in the “National Wetland Inventory wetlands” row is marked with an “X”. This means that layer is only appropriate for use in visioning and plan making.

13 The ‘Summary of Interpretation & Recommendations for Use’ column summarizes the recommendations of the N.C. Wildlife Resources Commission for use of this GIS data to conserve wildlife and habitats of conservation concern.

14 http://www.conservationtool.nc.gov

15 http://data.nconemap.com/geoportal/

16 The Natural Heritage Element Occurrence layer downloaded through the Green Growth Toolbox website or NC OneMap only has a minimal set of attributes. Because the full dataset contains sensitive information, it must be obtained by contacting the N.C. Natural Heritage Program Conservation Information Manager (www.ncnhp.org/web/nhp/contact).

17 http://www.ncwildlife.org/Conserving/Programs/GreenGrowthToolbox/ConservationData.aspx

18 http://www.fws.gov/wetlands/Data/State-Downloads.html

19 U.S. FWS Bald Eagle Management Guidelines and Permits. [Internet]. [2013]. U.S. Fish and Wildlife Service. Available from: http://www.fws.gov/midwest/MidwestBird/EaglePermits/baeatakepermit.html

20 Floodplain data is not available for download on the GGT website. The best available data for your county should be downloaded from http://www.ncfloodmaps.com.

SECTION 3. HABITAT CONSERVATION RECOMMENDATIONS

The purpose of this section is to provide conservation recommendations that are based on the scientific literature regarding how much habitat priority wildlife need in order to remain in developing landscapes. These recommendations come from two N.C. Wildlife Resources Commission (NCWRC) guidance documents referenced at the end of this section: the NCWRC (2012) conservation recommendations, available from www.ncwildlife.org/greengrowth and the NCWRC (2002) guidance to address cumulative impacts.[1] Many wildlife species need a large amount of habitat. We encourage readers to use this information to do what is possible to minimize negative impacts to wildlife through planning, policies, and development design. Because developed landscapes are becoming the face of our state, implementing these guidelines as much as possible in land use planning is essential to preventing the loss of much of our state's wildlife and biodiversity.

This section details the wildlife habitat conservation component of green infrastructure. Large habitat areas can be conserved by connecting contiguous habitat among different parcels. Habitat open space can be owned by the homeowner association, which can also fund habitat management.

NATURAL RESOURCE-BASED LAND USE AND DEVELOPMENT PRACTICES

Comprehensive natural resource stewardship includes conservation of priority wildlife species and habitats. Scientific research has revealed certain conservation thresholds, or minimum habitat area requirements, are needed to sustain priority species and habitats near built areas.

- Incorporating these recommendations in plans, incentives, ordinances, and development designs will help reduce the likelihood that species are placed on the federal endangered and threatened species list and reduce permit delays.
- We encourage local governments and developers to conserve as much habitat as possible as a first step, even if it is less than what is recommended.

How can this information be used?

In local government planning documents to inform:

- The goals, objectives, strategies, and natural resources component in all community planning documents (in addition to the N.C. Wildlife Action Plan).
- Policy recommendations.

In incentives and ordinances to inform:

- The proportion or width of open space conservation to consider in certain districts or development standards.

In development review and site design to inform:

- Review of development proposals to evaluate habitat conservation opportunities.
- Development designs that will enhance wildlife habitat conservation.

Referencing the Conservation Data for Green Growth

Habitats described in this section can be identified using the Conservation Data map layers described in Section 2. The **blue boxes** throughout this section highlight specific conservation map layers associated with habitat recommendations. The GIS map layers contain a data table with information on habitat type and can be searched or filtered.

Principles for Maintaining Healthy Ecosystems

Keep ecosystems and our communities healthy by maintaining a connected network of healthy habitats.

The land use principles below are basic guidelines for designing communities that maintain healthy ecosystems. These principles can be goals to help your community achieve Green Growth.[2]

MONTGOMERY COUNTY, MD PLANNING DEPT.

Wildlife Travel Corridor

1) Maintain large, wide blocks of contiguous habitat to avoid habitat fragmentation.
2) Maintain functional connections between core habitat areas that wildlife can travel through to avoid isolating habitats. Major roads and large developments, make wildlife travel difficult or impossible while working farms and forests are more conducive to species movement.
3) Protect rare landscape elements, sensitive areas and associated species. Not all open spaces are created equal. Natural open spaces—such as wetlands, riparian and native upland forests—will protect water, air, and wildlife much better than manicured open spaces.
4) Allow patterns of natural disturbance to continue, such as periodic fire and river flow patterns. Encourage habitat management, which can be funded by homeowner associations and parks departments.
5) Minimize the introduction and spread of nonnative, invasive species.
6) Minimize the human introduction of nutrients, chemicals, and pollutants, particularly near wetlands and streams.
7) Avoid and compensate for adverse effects of development on natural processes, such as the cumulative effects of stormwater runoff on aquatic ecosystems. Maintain or mimic the natural hydrology on development sites.
8) Avoid land uses that deplete or degrade natural resources in environmentally sensitive areas, including habitat for species of conservation concern.

Associated Conservation Data

Any areas that rank 1 – 10 in the Biodiversity and Wildlife Habitat Assessment are very important to ecosystem function.

Area Sensitive Species Need Large Core Habitat Areas


AURTHER GROSSET

black-throated green warbler


JEFF HALL

tiger salamander

Many of the over 370 wildlife species of conservation concern in North Carolina require large areas of habitat that have sufficient interior habitat. Interior habitat is an area of contiguous habitat far from an edge, or a transition to an incompatible land type. Interior habitat is maximized when habitats are more circular in shape and have minimal edge. Interior habitat is different for forest dwelling and grass or shrubland dwelling wildlife. Interior habitat for forest dwelling species begins approximately 350 feet from the edge of a large unforested or developed area. Sufficient habitat interior for grass and shrubland species is only present in agricultural landscapes with many grasslands greater than 20 acres. Grass and shrubland species need 125 to 250 acres of habitat in patches greater than 15 acres, in close proximity, in an urban setting. See pages 48 to 49 for more information.

Reduce Habitat Fragmentation and Maintain Wildlife Travel Corridors

In sensitive areas consider encouraging or requiring that wide contiguous natural open space be set-aside on developed parcels and that it be connected to natural open space on adjacent parcels. In priority areas maintain wildlife travel corridors that are at least 150 to 330 feet wide through development standards. Coupled with appropriate land use districts this will maintain interior habitat and connectivity in developed areas.

Maintain Agricultural or Conservation Districts Around and Between Managed Areas

- Development projects located adjacent to NC Wildlife Commission Game Lands and other Managed Areas degrade habitat quality within conserved lands and make prescribed fire difficult. See page 4 for information on prescribed fire. Ideally, agricultural districts should be maintained in these areas. Developments should try to create as wide a buffer as possible between built structures and public land boundaries.
- If buffers cannot be placed around entire Game Lands or in all Smoke Awareness Areas:
  - maintain buffers around narrow portions of Game Lands,
  - prioritize buffers along parts of Managed Areas where prescribed fire is used
  - and buffer areas mapped in the Biodiversity and Wildlife Habitat Assessment.

How much area is ideal?

- Within Smoke Awareness Areas, design a land use category, district or a development project so that a ½ mile smoke management buffer—or the widest buffer possible—without inhabited structures exists. This will minimize resident's exposure to smoke from prescribed fire every two to five years.
- If the development will occur adjacent to NC Wildlife Commission Game Lands, design a land use category, district or a development project so that permanently inhabited structures are located at least 150 yards from the edge of the Game Land.

Associated Conservation Data
- Managed Areas
- Game Lands Hunting Safety Buffer
- Smoke Awareness Areas

Core Habitat, Habitat Edge, and Connectivity

Maximum habitat interior (core habitat) and minumum edge

Maximum habitat edge and no interior habitat

Connect core habitat 'nodes' to prevent habitat fragmentation

Images courtesy of Benjamin Penington, 1000 Friends of Florida

Maintain large circular nodes (core areas) of habitat to maximize interior habitat and minimize edge. Habitat edges occur at the border of incompatible land and are generally detrimental to priority wildlife species because edges are more accessible to predators and parasites that reduce the survival of their young. For this reason, wider wildlife travel corridors are better. Wildlife also need to be able to travel through uninterrupted, contiguous habitat.

Conservation Recommendations for Upland Habitats

"Upland" habitats are terrestrial habitats that are located outside of the floodplain, wetlands and riparian zones. Priority upland habitats in North Carolina include longleaf pine forests, grasslands - shrublands (early successional habitat), high elevation habitats (above 3500 ft.), caves and mines, rock outcrops, and large, unfragmented forests.

Upland Forest Habitats

Associated Conservation Data

- Natural Heritage Natural Areas
- Natural Heritage Element Occurrences
- Biodiversity and Wildlife Habitat Assessment
- Forest Lands Assessment

- Try to conserve a connected network of forests and create plans to properly manage habitats post-construction.
- We recommend as little development as possible take place in: Natural Heritage Areas, areas with natural vegetation within Natural Heritage Element Occurrence polygons or within Landscape Habitat Indicator Guilds that rank a 7 to 10 on the Biodiversity and Wildlife Habitat Assessment.
- Try to conserve more than 50 percent of the total tree cover within your jurisdiction or at least 50 percent of forest cover within 1.5 miles of existing Managed Areas.
- Try to conserve larger, wide blocks of forest with less edge on open areas. This can be done by encouraging connection of natural open space among parcels. Forest dwelling priority species need the following areas of forest in North Carolina:
  - Contiguous upland, floodplain and wetland forest blocks of at least 500 acres in the Mountains, southern Piedmont and Coastal Plain.
  - Seventy-five contiguous acres of non-floodplain (upland) forests in the Piedmont and Coastal Plain can support most priority bird species.
  - Cerulean warblers in the southwest Mountains and many fire dependent species in the Sandhills and the Coastal Plain only occur in forests of over 1,750 acres.
  - Smaller blocks of forest have conservation value as bird migration stop over areas but do not support as many priority species.
- Longleaf pine forest needs to be managed with prescribed fire if fire-dependent wildlife are intended to be conserved.

Benefits of Conserving Forests

Forest protection provides many benefits. The NC Greenhouse Gas (GHG) Inventory estimates that NC's forests sequester 193.9 metric tons of CO_2e/per acre, offsetting 25 percent of North Carolina's gross GHG emissions.[3] Carbon storage benefits from conserved forests are estimated to be valued at $2,300 to $6,000 per acre. The health benefits related to improved air quality due to forest conservation is estimated to be valued at an average of $212 per acre ($18 to $2,500 per acre). Other co-benefits include: water quality improvements into our reservoirs, which translate into increased value of recreation ($1 to $7,000 per acre) and lake-shore property values ($1 to $1,500 per acre), and reduced water treatment costs ($3 to $270 per acre).[4]

Grassland Habitats

Many grasslands are not mapped, but can be defined as pastures and fallow fields of at least 20 acres in agricultural landscapes and 15 acre fields in close proximity, totaling 125 to 250 acres, overall, in urbanizing areas.

- Develop farmland protection plans and integrate grassland and early successional habitat conservation and management recommendations.
- Focus on policies that maintain viable, contiguous working farms.
- Re-vegetate utility rights-of-way into grassland or shrubland habitat using native plant species and establish rotational vegetation control schedules. Native plants use less water and require less maintenance.
- Mow half to one-third of grasslands per year to maintain habitat structure. Try to mow only from mid-March and mid-April to reduce impacts to ground nesting birds.
- Prescribed fire can produce better habitat at less cost than mowing or herbicides.
- Utilize and promote the many state and federal programs that provide monetary and technical assistance for landowners to create and maintain early successional habitats (www.ncwildlife.org/CURE.aspx). Many of these programs can also be used for prescribed burning of longleaf pine forest as well.
- If your community has the resources to conduct active resource management, prioritize the protection and management of some early successional habitat when purchasing land for open space. Consult with a qualified biologist to develop a management plan for long-term management of this habitat.
- When early successional habitat is to be protected as open space in a development project, require applicants to submit 1) a long-term habitat management plan, and 2) plans to fund long-term management. Habitat management can be funded and administered by the homeowners association.

Associated Conservation Data

- Agricultural Lands Assessment
- Natural Heritage Element Occurrences for grassland wildlife species
- Aerial photos (available on NC OneMap)

Riparian Habitat Conservation Recommendations

Protect wide forest areas along streams.

Benefits of Conserving Forested Riparian Buffers

- Some of the greatest environmental health benefits come from improving downstream water quality and reducing the intensity of floods and droughts.
- Forest soils and root systems filter up to 15 inches of water per hour storing and cleaning water while preventing floods and drought.[5]
- The riparian forest along rivers and streams is the sole source of the food base (leaves) and shade necessary for fish and other aquatic life to live in streams.
- Once pollution is released in water, the only things that keep air and water clean are the animals and plants that remove pollutants through filter feeding.
- Forests adjacent to streams support a high diversity and abundance of wildlife. Protecting wide buffers around rivers and streams in as many places as possible is necessary to preserve habitat for species using riparian zones.
- Protection and restoration of riparian corridors has a large potential for carbon sequestration and storage.

All recommended stream buffers presented here are mapped in the Biodiversity and Wildlife Habitat Assessment

What conservation measures are needed?

- Forested buffers comprised of native trees and plants are recommended around all streams (perennial, intermittent and ephemeral channels).
- Because wider buffers produce the most environmental benefits and also safeguard communities, we recommend protecting and maintaining the maximum width buffer possible in as many places as possible along streams.
- If wide buffers are not possible everywhere, focus on buffers in priority watersheds (see page 26). Conserving large 'nodes' of wide buffers can be encouraged through development standards.
- We recommend that impervious surfaces be kept below 10 percent within all watersheds in order to safeguard aquatic life and fishing.

Stream Buffers to Protect Water Quality for Aquatic Life[6]

Recognizing that wider is always better and that some buffer is better than no buffer, the NC Wildlife Commission typically recommends the following buffer widths to minimize impacts to aquatic species (such as fish and mussels):

- In subwatersheds **without federally listed aquatic species:**
  - Preserve 100 foot native, forested buffers on *each side* of perennial streams.
  - Preserve 50 foot native, forested buffers on *each side* of intermittent streams.
- In subwatersheds **that contain federally listed aquatic species**:
  - Preserve 200 foot native, forested buffers on *each side* of perennial streams.
  - Preserve 100 foot native, forested buffers on *each side* of intermittent streams.
- In all watersheds, buffer ephemeral streams and drainages. Narrower buffers than those recommended for perennial streams will suffice, but again, wider is better.
- Note that subwatersheds containing federally listed species are identified in the Conservation Data for Green Growth.

M.C. BARHART

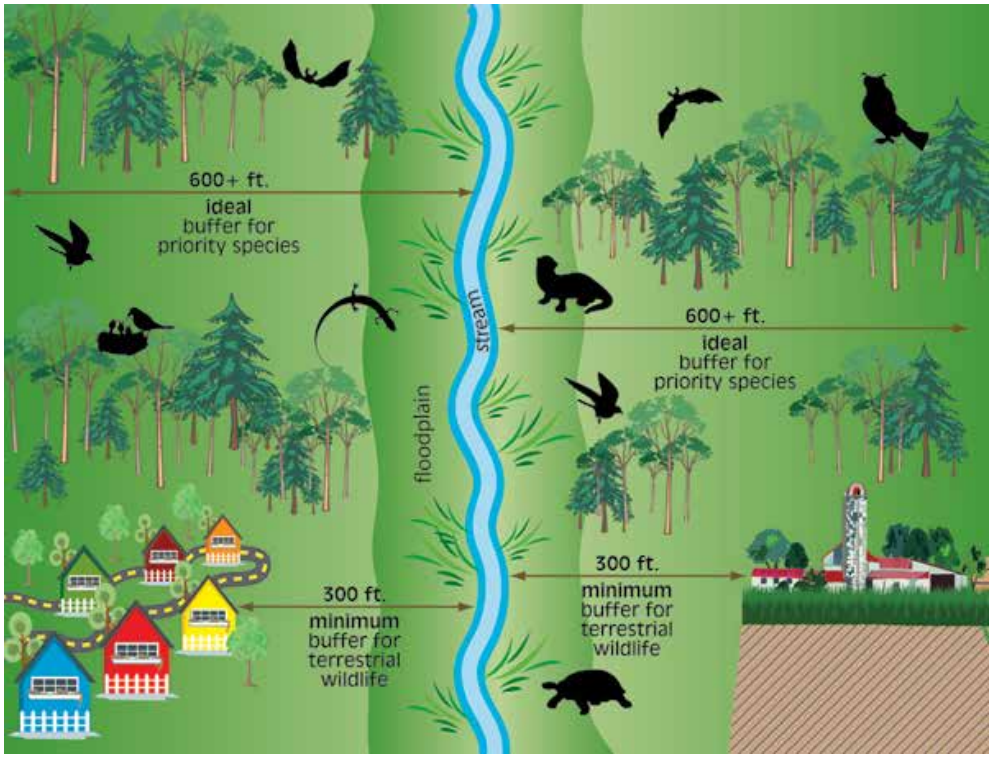
Freshwater mussel filtering water and removing pollutants.

Why are stream species important?

Freshwater mussels are an important signal of our own health. They clean our water by filtering bacteria and chemicals. Without enough forest along streams to soak up rain water, sediment and other pollutants can reach levels that kill the aquatic life that help to keep our water clean and safe.

Associated Conservation Data

- Biodiversity and Wildlife Habitat Assessment
- 'hydro_24k' streams layer includes DWR stream class
- Subwatersheds with Federally Listed Fish and Mussels
- Outstanding Resource Waters and and High Quality Waters
- Natural Heritage Natural Areas
- Natural Heritage Element Occurrences



GRAPHIC BY KIMBERLY KC SCHOTT, RED GATE DESIGN

Riparian Forest Habitat and Wildlife Travel Corridors

A majority of wildlife rely on riparian forest zones to raise their young and to feed. As such, wide riparian forest buffers are needed to conserve a majority of wildlife.

- Protect wide forested buffers of 300–600 feet or more on each side of the stream. Research has shown this will provide sufficient travel corridors and some habitat for forest interior birds (such as the wood thrush), while 250 foot buffers are needed for most stream salamanders.[7]
- Other species of conservation concern, however, require forested travel corridors at least 1000 feet wide.[8] This is why it is important to conserve some nodes this wide along streams and rivers where possible.
- Use the relevant Conservation Data to identify priority places for wide stream buffer areas and habitat nodes if wide buffers are not possible along entire waterways.
- Wide riparian forest buffers can be achieved through properly designed and managed greenways.

Recommendations for Minimizing On-Site Stream Impacts

In addition to protecting wide riparian buffers, incorporating the following practices into the design and construction of development projects will help minimize negative impacts to aquatic species and habitats.

- Identify and delineate all streams using the N.C. Division of Water Resources criteria. See https://edocs.deq.nc.gov/WaterResources/DocView.aspx?d-bid=0&id=2488192&cr=1 for information.
- Refer to the NCWRC (2002) guidance to address cumulative impacts available from www.ncwildlife.org/Conserving/Programs/HabitatConservationProgram.aspx.

Recommendations for Floodplains

Rapid development in some parts of North Carolina is leading to changes in floodplain boundaries and flooding frequency. Floodplains may widen and become more inundated due to urbanization.

Benefits of Floodplains

In addition to helping to protect communities from flood hazards, intact floodplain forests and wetlands store 2.1 billion MT CO_2e and sequester 10 million metric tons CO_2e each year in NC.[9] Floodplains are a priority wildlife habitat identified in the N.C. Wildlife Action Plan. Conservation can greatly help to keep species off of endangered species lists.[10] Many floodplain pools provide important habitat for breeding turtles, salamanders and frogs. When floodplain corridors are intact, they provide migration corridors for birds and mammals.

Conserve Floodplains

- Where the floodplain is wider than required stream buffers, protect the full extent of the 100-year floodplain.
- Where feasible, do not place sewer lines, water lines, manholes, and other utility infrastructure in the 100-year floodplain.
- Try to avoid clearing, excavating, filling, altering, draining, or placing structures of any kind within the floodplain boundaries. This will also help to prevent or reduce the burden to taxpayers from disaster clean up.
- Consider extending these practices to the 500-year floodplain to safeguard against increasing extreme flood events.

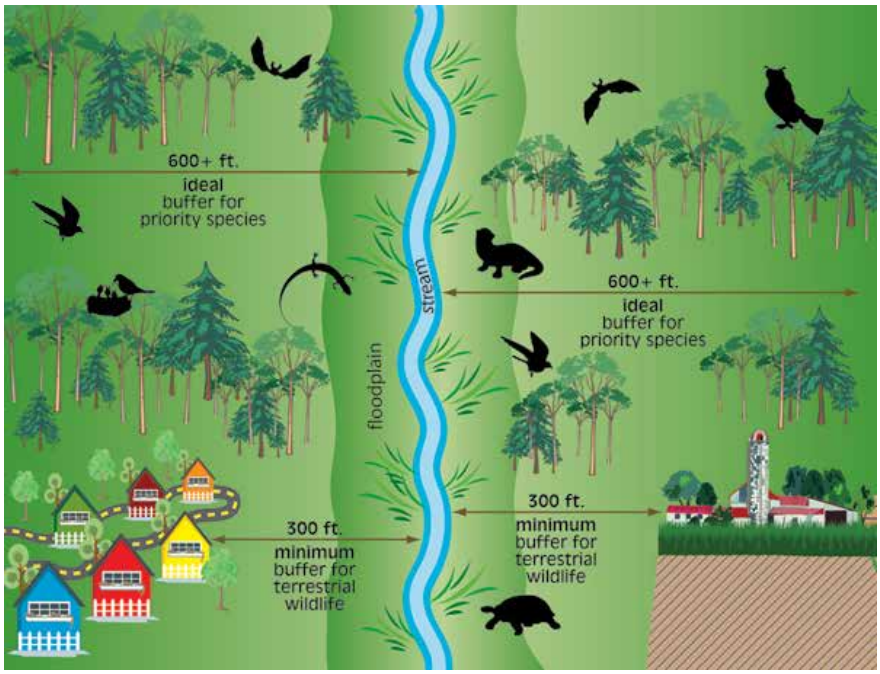
Stewarding Floodplain Property

In addition to keeping built areas outside of the floodplain, plans are needed to minimize floodplain impacts during and after construction.

- Floodplain land can be dedicated and deeded to the local government, homeowners association, or land trust as permanent open space.
- In partnership with a qualified natural resource manager, develop plans to properly manage floodplain wetland resources during and post-construction. See pages 54 to 57 for wetlands recommendations.

Associated Conservation Data

- 100 and 500-year floodplains from the N.C. Floodplain Mapping Program



GRAPHIC BY KIMBERLY KC SCHOTT, RED GATE DESIGN

Recommendations for Greenways

- Greenways are a great community resource for providing recreation opportunities and for connecting core habitat areas.
- Maintain forested areas at least 1,000 feet wide over as much of the greenway as possible. This has been shown to conserve the full suite of forest wildlife habitat.
- Greenways that are at least 330 feet wide still offer breeding habitat to some forest interior species.
- Greenways that are 150 feet wide provide wildlife travel corridors for some priority species but do not provide enough breeding habitat for most species.
- If wide greenway areas are not possible along the entire greenway, nodes of wide habitat areas should be encouraged for conservation along thinner areas.
- Locate trails toward the edge of the greenway rather than the middle and keep trails as far as possible from streams, ideally 100 feet away.

Conserving Wetlands for Declining Wildlife

Protect wide upland buffers around wetlands, especially small wetlands.

Benefits of Wetlands Conservation

Wetlands are important because of their role in helping to mitigate floods and droughts, purifying and storing surface water and for providing important wildlife habitat, particularly for amphibians and reptiles. Dramatic amphibian and reptile declines are occurring around the world due to habitat loss and road construction, among other factors. As with streams, wider buffers will produce the most environmental benefits. Wetland communities are identified as a priority for conservation in the N.C. Wildlife Action Plan.[11]

Small Wetland Communities

Small wetland communities include isolated upland pools, vernal pools, springs, bogs and seeps, where surface water collects or ground water feeds the beginning of a stream. These wetlands are not connected to water from the main body of a stream or river and are usually temporarily flooded such that they are dry for much of the year. They typically fill with water during the winter and hold water into the spring and early summer. Because they do not support fish, which prey heavily on amphibian eggs, these wetland communities provide the only breeding habitat for many amphibians and some reptiles. Vernal pools and other small wetland communities are often overlooked during land conversion because their protection is often not regulated and because they are small and dry for part of the year. As such, they have undergone extensive decline. Wetlands may become more threatened as weather events become more extreme. Frequent extreme flooding and drought can cause local wetland species extinctions.

Wetland Buffers for Water Quality

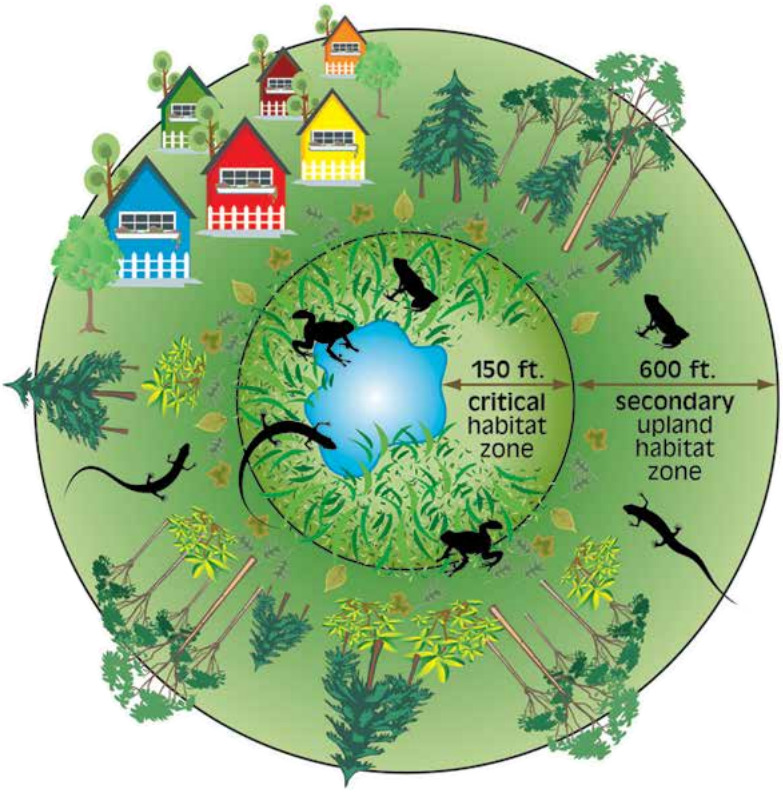
- To minimize negative impacts to water quality associated with wetlands along streams, at minimum 100 foot buffers are needed for wetlands on perennial streams and 50 foot buffers are needed for wetlands on intermittent streams.[12] To conserve wetland wildlife habitat wider buffers are needed.

Buffers Needed to Protect Wildlife Habitat at Small Wetlands

Buffer widths that will protect basic water quality are more narrow than buffers needed to protect wildlife habitat at small wetlands. Amphibians and reptiles live part of the year far from the wetland pool in the surrounding upland forest where they forage and burrow to escape extreme temperatures. As such the intensity of land use surrounding the wetland pool will affect wildlife diversity and abundance in small wetlands. In addition, the amount of disturbance and development in a watershed affects local extinction of amphibians.[13]

The following buffer recommendations based on the scientific literature are particularly important to reducing threats to wildlife and our communities caused by extreme flooding and drought.

- Maintain a 150 foot Critical Habitat Zone around each wetland pool, that is undisturbed to ensure that many wetland species are not lost from development.
- A Secondary Upland Habitat Zone of an additional 600 feet is needed to protect core habitat for many semi-aquatic reptiles and amphibians.[14] This Secondary Upland Habitat Zone does not need to be symmetrical and can be more narrow or wide in places.
- Habitat conservation can still be achieved when 25 percent of the Secondary Upland Habitat Zone is developed in a clustered manner.



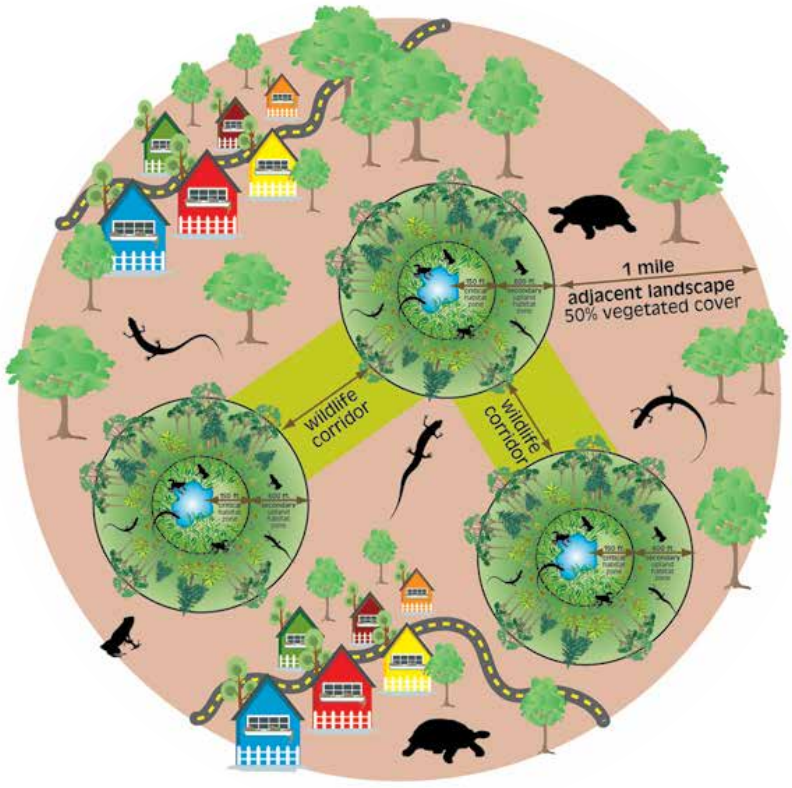
GRAPHICS BY KIMBERLY KC SCHOTT, RED GATE DESIGN

Limit Impacts of Development Near Wetlands

- Maintain the maximum amount of upland habitat possible around and between wetlands.
- Minimize impervious surfaces around wetlands, particularly pools with many different amphibian and reptile species.
- Exclude roads and driveways from upland areas within 750 feet of priority wetland habitats.
- If roads must run between important wetlands, install wildlife underpasses to allow for reptile and amphibian movement under roads between wetlands. See page 66 for information on wildlife road crossing structures.
- Cluster development and place houses as far away from upland pools as possible.
- Do not use small wetlands for stormwater retention ponds and locate retention ponds at least 750 feet from small wetlands to minimize hydrological disturbance to natural water flow into small wetlands.

Associated Conservation Data

- Natural Heritage Natural Areas
- Natural Heritage Element Occurrences
- The National Wetlands Inventory or Coastal Region Evaluation of Wetland Significance



GRAPHICS BY KIMBERLY KC SCHOTT, RED GATE DESIGN

Maintain Small Wetland Complexes and Priority Wetland Regions

- As much as possible, avoid placing development and roads between small wetlands that are within 1 mile of each other.
- Connect wetlands to one another and to streams via forested wildlife travel corridors that are made to be as wide as possible and at least 330 feet wide.
- Limit impervious surfaces to 10 percent and road density in watersheds that contain your jurisdiction's most biologically diverse and important wetlands.
- Maintain at least 50 percent natural vegetation in large, connected nodes throughout the landscape.

WILDLIFE CONSERVATION IN CONSTRUCTION AND POST-CONSTRUCTION[15]

Wetlands Management Plan Guidelines

To manage wetlands, streams and floodplains during and after construction:

- Avoid the use of insecticides and herbicides within or adjacent to buffer areas.
- Avoid removal of forested tree cover or leaf litter and any soil disturbance in the surrounding upland forest.
- Eradicate and do not plant invasive, exotic vegetation.
- Covenants or deed restrictions can be used to ensure wetland habitats are managed properly by future homeowners or the homeowner association.

Recommendations for Stormwater

Manage stormwater on-site with structures that maintain natural hydrology and provide habitat.

State and federal law requires the implementation of certain stormwater management standards which affect many communities in North Carolina. The recommendations below are not intended to replace legal requirements.

These recommendations explain how a development project must manage stormwater in order to be beneficial for wildlife and better safeguard the community from heavy rain events and flash flooding.

- Control stormwater on-site and design stormwater management structures to mimic predevelopment hydrographic conditions.
- Incorporate "low impact development" (LID) practices into site design, such as capturing rainwater for irrigation use and incorporating rain gardens into residential landscaping. LID provides significant cost savings. Information about LID can be found at the following websites:
    - N.C. State University *Low Impact Development Guidebook* https://www.uni-groupusa.org/PDF/NC_LID_Guidebook.pdf
    - Cost benefit information - www.epa.gov/nps/urban-runoff-low-impact-development
    - Stormwater Manager's Resource Center - www.stormwatercenter.net
- Do not discharge stormwater to streams through pipes or ditches. Stormwater should only be released in a dispersed manner through vegetation.
- Avoid using wetlands for stormwater discharge or retention ponds.
- Design stormwater retention ponds to also provide or maintain wildlife habitat of native trees, shrubs and other plants around detention ponds.
- Create rain gardens with native plants and wildlife-friendly materials.

Recommendations for Sediment and Erosion Control

Minimize land clearing and grading.

Construction practices that completely clear and grade the landscape are extremely harmful to water quality, terrestrial and aquatic wildlife resources. Such practices often cause the loss of topsoil, forest cover and the sedimentation of streams and water bodies, which

can be devastating to entire ecosystems in your community.[16] The following wildlife friendly development practices will help minimize these harmful impacts:

- Minimize all clearing and grading associated with construction, particularly adjacent to waterways and steep slopes.
- Only perform clearing and grading based on a stream protection strategy.
- Instead of clearing and grading to landscape a site, retain as much natural vegetation and soil cover as possible.
- Phase construction to reduce the area and time over which soils are disturbed.
- Stabilize soils as quickly as possible (< 2 weeks) by establishing a native grass or mulch cover.
- Establish appropriate perimeter controls at the edge of construction sites to retain or filter concentrated runoff from relatively short distances before it leaves the site.

Recommendations for Impoundments

Minimize the negative effects of impoundments on wildlife.

Ponds and other small impoundments, if not properly constructed and managed, can negatively impact water quality as well as aquatic habitats and species. In-stream impoundments can negatively impact fish migration, reduce aquatic ecosystem diversity and abundance and introduce nonnative species that reduce ecosystem health. With thousands of ponds and small in-stream impoundments in North Carolina, the level of cumulative negative impacts on the state's streams is high.

To minimize the negative effects of impoundments when designing a development project:

- Locate impoundments away from stream channels. Locate ponds on stream channels only when there is no other option.
- Avoid constructing impoundments near existing wetlands to avoid altering the hydrology of that wetland.
- Avoid locating ponds in naturally reproducing trout waters, anadromous fish species waters and waters that contain state or federally listed species.

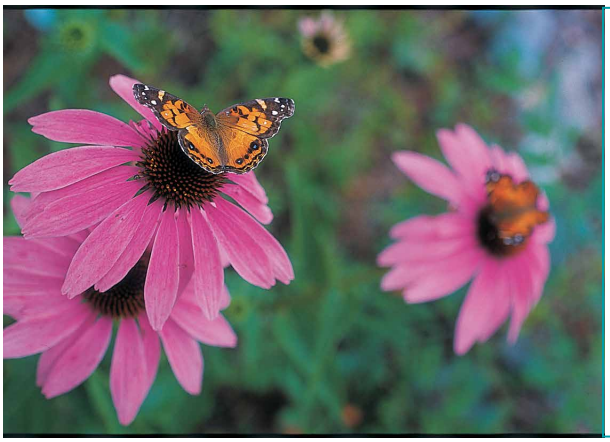
Recommendations for Right-of-Ways

Construction of utility right-of-ways (ROW), when properly maintained, can provide habitat for birds, reptiles and mammals.

To minimize wildlife impacts and maximize wildlife benefits:

- Minimize grading and retain large trees at the edges of construction corridors.
- When disturbing the soil, stabilize it as quickly as possible. Reseed with wildlife-beneficial seed mixtures (e.g., native warm season grasses or creeping red fescue, native seed or fruit producing plants and so forth).
- Avoid planting fescue (except creeping red fescue) or Bermuda grass based mixtures because these are invasive and provide little wildlife benefit.
- Keep brush piles of woody debris at the edges of cleared ROW. These provide good cover and food.
- Allow corridors to re-vegetate into a brush or scrub habitat.
- Minimize ROW corridor maintenance and mow only between mid-March and mid-April to minimize impacts to ground nesting birds.

Going Native!



North Carolina State University's website Going Native! presents a step-by-step guide on how to landscape with native plants. The website also presents photos and descriptions of nonnative, invasive species. Planners, developers, engineers, landscape architects and homeowners will benefit from using this guide at www.ncsu.edu/goingnative/. The Audubon Society has many native plant resources, including a Plant Database where the user can input their zipcode and get a list of plants native to their area. www.audubon.org/native-plants. Also, see the N.C. Native Plant Society for native plant suggestions and suppliers at www.ncwildflower.org/index.php.

Recommendations for Landscaping

Create landscaping plans that will benefit wildlife.

Use Only Native Plants

One of the most important components of a wildlife friendly landscaping plan is using native plants and removing invasive, exotic plants where possible. Native plants are more nutritious for important pollinators and wildlife. Invasive, exotic plants often out-compete and gradually displace our native plants. This negatively impacts native wildlife and the overall health and stability of our environment.

- Avoid planting invasive, exotic plant species and, where practical, remove such species from the development site. Lists of invasive plants and methods for removal can be found in the, "Southeast Exotic Pest Plant Council Invasive Plant Manual," at www.se-eppc.org/weeds.cfm or through the North Carolina Botanical Garden's website at http://ncbg.unc.edu/invasive-plants-resources/.
- The N.C. Forest Service provides guidance on street tree selection. See their website at https://www.ncforestservice.gov/Urban/urban_recommendedstreettrees.htm for lists of trees and guidance on which trees are best suited for different sites.
- Avoid using insect resistant plants. Birds feed their young entirely on insects and are threatened by a reduction in insects.

Attract Birds and Butterflies for Wildlife Watching

In addition to using only native plants, landscaping plans can incorporate design elements that will attract popular species for wildlife watching. To attract birds, butterflies, and other "watchable wildlife" species include these landscaping practices:

ERNIE MCLANEY

- Limit the amount of lawn. Replace lawn area with islands of native vegetation planted with native ground cover or wildflowers.
- Increase "vertical layering," or planting vegetation of different heights.
- Plant a butterfly garden.
- Create birdbaths or small ponds.
- Provide bird or bat houses and bird feeders.
- Reduce pesticide use.
- Do not use insect resistant plants.

Habitat Management is Important

Many developments, local parks and even utility lines that contain priority habitats need to conduct habitat management activities to truly conserve habitat for highly sensitive priority species. For example:

- Grasslands and shrublands will grow into forests if they are not mowed or burned.
- Longleaf pine forests need to burn every few years in order to maintain the grassland savannah structure that priority wildlife require. Longleaf pine forest species cannot live in dense thick forests dominated by hardwood trees, even if longleaf pine trees are present.

Habitat management in developments can be funded and administered by the home or property owner association dues. In local parks and public utility lines the local government can support habitat management. Habitat management recommendations are provided throughout this section and in the NC Wildlife Commission (2012) conservation recommendations document that can be included in habitat management plans and activities.

REGIONAL DEVELOPMENT PRACTICES

Different development practices may be needed to create wildlife-friendly developments in different regions of the state, for example:

- Development projects in the mountains will need to avoid building on steep slopes.
- Development projects on the coast will need to protect shorebird nesting areas.
- Longleaf pine forest only benefits rare species when blocks of 2000 acres can be con served as contiguous area among parcels and when prescribed burning is done.
- Small wetlands in the Sandhills and the Coastal Plain need wider upland forest buffers of more than 1000 feet and prescribed fire because the amphibian and reptile species in these regions need more space due to their unique habitat needs.

Regional wildlife friendly development practices are outlined in regional appendices to the Green Growth Toolbox handbook and in the NC Wildlife Commission (2012) conservation recommendations document referenced below. Visit the Green Growth website at www.ncwildlife.org/greengrowth to download these documents.

For More Information

Many resources provide information on ways to review and design development projects that will minimize impacts to wildlife habitats and important biological resources. A few of these are listed below.

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1 Information produced by an extensive review of the scientific literature for wildlife in the southeastern U.S. by the N.C. Wildlife Commission and other N.C. species experts. The resulting NCWRC documents are: a) NCWRC. 2012. Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina. North Carolina Wildlife Resources Commission Raleigh, N.C. Available from: www.ncwildlife.org/greengrowth and b) NCWRC. 2002. Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality. North Carolina Wildlife Resources Commission Raleigh, N.C. Available from: www.ncwildlife.org/Conserving/Programs/HabitatConservationProgram.aspx.

2 These nine guidelines were drawn from McElfish (2004). Nature Friendly Ordinances. Washington DC: Environmental Law Institute, and Dale et al. (2000). Ecological Society of America report: Ecological principles and guidelines for managing the use of land. Ecological Applications 10: 639-670.

3 N.C. Department of Environmental Quality. (2019, January). North Carolina Greenhouse Gas Emissions Inventory: (1990 – 2030). North Carolina Division of Air Quality. Retrieved from https://deq.nc.gov/energy-climate/climate-change/greenhouse-gas inventory.

4 North Carolina Natural and Working Lands Action Plan. June 2020. Department of Environmental Quality, Raleigh, NC.

5 PA Trees. Trees and forests reduce impacts of stormwater [Internet]. [Cited 2012 Dec 14]. Available from: www.patrees.org/trees-reduce-stormwater.

6 Ibid. 1.

7 Crawford, J.A. and Semlitsch, R.D. 2007. Estimation of Core Terrestrial Habitat for Protection of Biodiversity. Conservation Biology 21(1):152-158.

8 Mason, J., Moorman, C.E., Hess, G., and Sinclair, K. 2006. Designing suburban greenways to provide habitat for forest-breeding birds. Landscape and Urban Planning, 1-13; Sinclair, K.E., Hess, G.R., Moorman, C.E., and Mason, J.H. 2005. Mammalian nest predators respond to greenway width, landscape context, and habitat structure. Landscape and Urban Planning, 71, 277-293.

9 North Carolina Natural and Working Lands Action Plan. June 2020. Department of Environmental Quality, Raleigh, NC.

10 N.C. Wildlife Resources Commission. 2015. North Carolina Wildlife Action Plan. Available from: www.ncwildlife.org/plan.aspx.

11 Ibid. 7. "Small wetland communities," Pp. 185-188, 256-259.

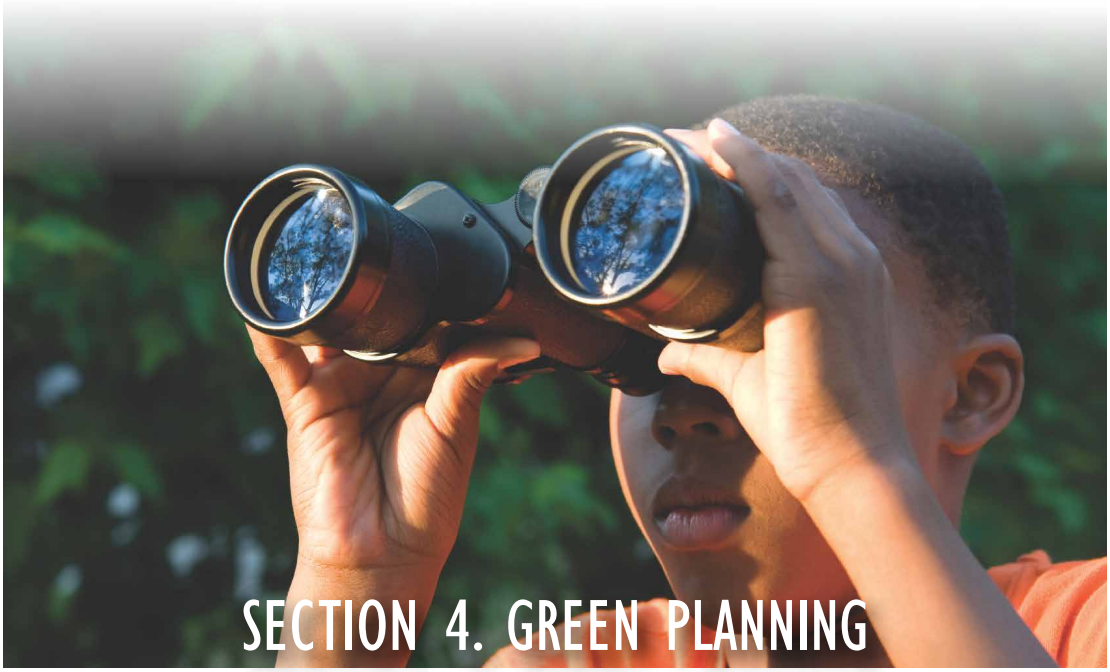
12 These numbers should be doubled in watersheds that support federally listed species

13 Willson, J.D. and Dorcas, M.E. 2003. Effects of Habitat Disturbance on Stream Salamanders: Implications for Buffer zones and Watershed Management. Conservation Biology 17(3), 763-771; Rubbo, M.J. and J.M. Kiesecke. 2005. Amphibian Breeding Distribution in an Urbanized Landscape. Conservation Biology, 19 (2): 504-511; Houlahan, J.E. and C.S. Findlay. 2003. The Effects of Adjacent Land Use on Wetland Amphibian Species Richness and Community Composition. Canadian Journal of Fisheries and Aquatic Sciences. 60: 1078-1094

14 Semlitsch, R.D. and Bodie, J.R. 2003. Biological Criteria for Buffer zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology 17(5), 1219-1228; Semlitsch, R.D. and Jensen, J.B. 2001. Core Habitat, Not Buffer zones. National Wetlands Newsletter 23(4), 5-6, 11.

15 These recommendations were drawn primarily from the N.C. Wildlife Resources Commission's (2002) Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality. Available from: www.ncwildlife.org/Conserving/Programs/HabitatConservationProgram.aspx.

16 Ibid.



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ENABLE WILDLIFE AND HABITAT CONSERVATION THROUGH VISIONING AND PLAN-MAKING

Green planning involves crafting the vision, goals, strategies and implementation sections in all planning documents that will enable conservation of important species and ecosystems and build resilience to increasingly severe weather events as your community grows. In this section we provide guidelines on ways to include this priority in the following:

- Community-wide visioning documents
- Conservation plans
- Land use and comprehensive plans
- Transportation plans
- Park, greenway, and open space plans
- Farmland protection plans
- Watershed management plans
- Risk assessment, climate resilience, and hazard mitigation plans
- Strategic and economic development plans
- Green building and energy efficiency plans

Six Step Conservation Planning Process

Many communities identify a need for wildlife and natural resources conservation in planning. The following six step planning process will help to incorporate wildlife and habitat conservation in green infrastructure or conservation plans, land use, transportation, hazard mitigation, and other plans.

Step 1. Identify and describe the status of priority species and habitats in your community.

Identify the species, habitats, and ecosystems that are of particular conservation interest or concern in your study area.

a) Consult the Conservation Data for Green Growth – Download and create maps that display priority habitats and ecosystems in and adjacent to your community.

What are

wildlife and habitat conservation priorities?

Conservation priorities are species, habitats, ecosystems or landscapes that conservation organizations are currently involved in protecting or that your community is particularly interested in. Scientifically-determined conservation priorities in North Carolina include priority wildlife species and habitats identified in the N.C. Wildlife Action Plan, rare species and natural communities identified by the N.C. Natural Heritage Program and landscapes identified by statewide assessments like the N.C. Conservation Planning Tool. Conservation priorities can also include other natural resources, such as areas that protect drinking water, important forest lands and agricultural lands. See page 17 for a list of priority habitats and Section 2 for maps of conservation priority areas in North Carolina.

b) Conduct any needed field inventories – Additional field inventory work may be needed to provide more complete information on important natural resources. If inventories cannot be completed in a timely manner, the plan should not be delayed but should allow for updates of new information.[1] See page 39 for information about conducting inventories.

c) Identify and display maps of wildlife and habitat conservation priority areas - Use the Conservation Data in Section 2 and local knowledge to analyze, map and describe the status of species, habitats and ecosystems. Below are a few questions you can use as a guide to identify important natural resources in need of conservation.[2]

- What is the condition of the species, habitats, and ecosystems in your community?
- How well protected are your habitat and natural resource priorities?
- Where are the areas that could serve as wildlife travel corridors, to maintain as agricultural and conservation development districts between natural areas?
- What outside forces are likely to negatively impact these linkages in the future, such as future development and extreme weather events?
- Are there conservation priorities outside your community's planning jurisdiction that may affect your area? If so, are they linked to natural areas within your community? If not, is there a potential to create a linkage?

Step 2. Through a public process, establish a conservation vision and set conservation goals for your community.

The vision statement can outline the specific attributes of the natural environment that community members would like conserved.

- Prior to writing the vision statement, you may want to develop a list of conservation "issues" the public thinks are important. This list—and information collected about these issues—can inform the vision and goal statements.
- Once stakeholders in your community agree on a conservation vision statement, conservation goals can be drafted.
- Then, outline concrete, measurable objectives to be followed in order to achieve each goal.

Avoid vague language in setting goals. Plans that are too vague in defining their goals and objectives are often not effective in realizing those goals.

Goals that will lead to wildlife and natural resources conservation include:

- Conservation of a network of connected natural habitats and resources
- Greenways are designed to conserve priority wildlife habitats
- Development patterns are less spread out and more centralized in all districts
- Conservation planning is coordinated with neighboring counties and municipalities

Objectives that support wildlife and natural resources conservation include:

- Revising land use districts and development standards to use land more efficiently and to better conserve contiguous, large, priority habitat core areas
- Setting targets for acres of priority habitats that should be conserved
- Creating a conservation district for highly sensitive areas in your community where a percent of contiguous natural open space will be set aside in new developments

Step 3. Develop conservation strategies to achieve goals.

The conservation strategies you select should be designed to implement your vision, goals and objectives. A menu of conservation strategies is presented later in this section.

Step 4. Identify ways to implement the conservation strategies.

Each conservation goal and strategy outlined in your plan should be linked to objectives and information stating who is responsible for doing what and by when. Prioritize implementation activities and present a timeline for completing tasks.

Step 5. Write the conservation plan.

- In addition to creating a stand-alone plan, it is important to integrate the implementation schedule and the vision, goals, maps and strategies into all planning documents
- If possible, obtain grant funds to hire a consultant to write your conservation plan. You will want to make the consultant aware of this Toolbox and the resources it includes.

The Implementation Crisis

Recent research suggests that conservation planning is, "mired in an implementation crisis."[5] In other words, conservation plans are being developed...but not carried out.

Focusing on the implementation accountability, funding and budgeting can help to turn plans into action.

Step 6. Implement the plan and monitor progress.

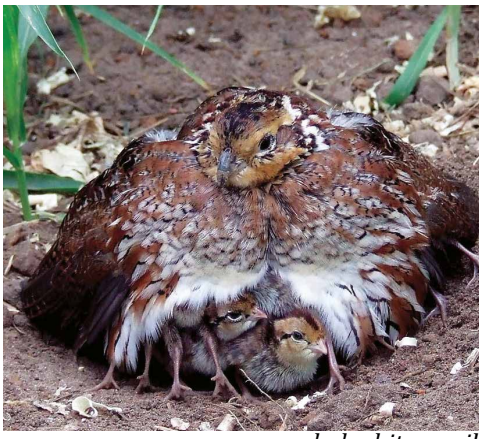
The final step is to include implementation activities in budgets and work schedules, create a network for implementation support and monitor your progress using practical measures of success. Ideas for implementation are provided throughout this section.

Developing a County or City-Wide Conservation Plan

Creating even a simple, brief jurisdiction-wide conservation plan is the most effective way to help ensure the realization of your community's vision for conserving wildlife, habitat and other natural resources.

Examples of Conservation Plans in the North Carolina

- The Comprehensive Conservation Plan for Chatham County, NC[a] was funded by external grants and was created by a partnership of scientific experts, community members, the planning department, and elected officials.
- New Hope Corridor Open Space Master Plan, Durham City & County, Town of Chapel Hill, Orange County, NC[b] was a joint conservation planning effort to protect New Hope Creek which resulted in an inter-jurisdictional advisory board that provided input on development proposals within conservation priority areas



RANDY CASE, TALL TIMBERS RESEARCH STATION, FL

bobwhite quail

Greening Existing Plans

A good compromise for busy communities

Depending on your community's immediate priorities it may be easier to write a habitat conservation section for your land use, transportation or comprehensive plan. It is important to incorporate habitat conservation goals, objectives and strategies into other sections of all local plans to fully enable habitat conservation.

The process of writing a habitat conservation section for an existing plan is less in-depth but follows the same general process as the six step process outlined above.

Leverage all of your conservation resources.

Utilize complementary public investment grants and programs.

- Public investments are expenditures toward the future public good, such as roads, water and sanitation. Public investments also need to be made to support a community's natural assets through funding conservation education and planning, land acquisition, transaction costs for conservation easements and habitat steward ship on locally owned public lands. Funds can come from external grants but also from bonds and minimal fees.

Collaborate with local, state and federal natural resource agencies.

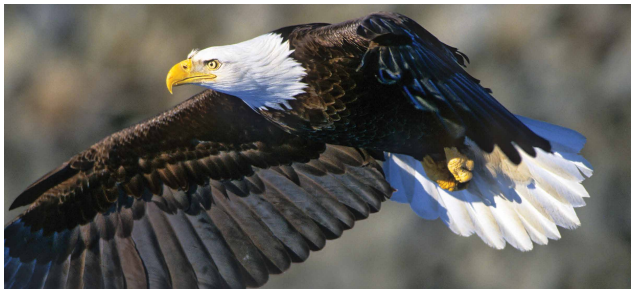
- Call on your local land trust, Soil and Water Conservation District and Extension agency to assist with conservation planning and projects. See Appendix B for a list of organizations that can provide technical assistance.

Use the best conservation data and strategic planning tools available.

- Integrate and regularly update conservation GIS data in the community's online GIS mapping application or local government computer network.
- Use land use planning software that evaluates the fiscal impact of decisions. NatureServe Vista[c] is a free ArcMap 10 Extension based on CommunityViz that measures the benefits of conservation decisions for land use planning

a https://www.chathamconservation.org/home/chatham-conservation-plan
b https://www.newhopecreek.org/history.html#planpdf
c https://www.natureserve.org/products/natureserve-vista

Green Infrastructure Planning


bald eagle

In that last decade, green infrastructure planning has taken off as a preferred framework by local governments to plan for conservation of natural resources, including biodiversity. The central principle of green infrastructure is to plan the green before the gray. It is important to include the information in Section 3 to effectively conserve wildlife habitat, which is not fully addressed in green infrastructure guidance. See the Conservation Fund website[d] for more information (search term "green infrastructure").

A MENU OF CONSERVATION STRATEGIES[3]

Listed below is a menu of planning strategies that can help your community achieve its conservation goals.

Involve local citizens, businesses, landowners and other representatives from every interest group in conservation visioning exercises.

- Ask stakeholders to rate how important wildlife and habitats are to them to demonstrate the level of demand for conservation in the community. If you do not have the resources for this, poll your Planning Board or Board of Commissioners.
- Arrange mapping workshops with representatives of every interest group and ask them to identify important conservation areas on maps. Consider using the Conservation Data for Green Growth and identifying target growth areas.

Include language in planning documents detailing the importance of conserving areas of high wildlife and biodiversity value.

- During the planning document updates include information about wildlife and habitats from existing statewide and local conservation plans (see page 71).
- During the plan creation or update process, propose that information be included on the benefits of Green Growth from Section 1.

Translate conservation goals and objectives into policies in the land use, transportation or comprehensive plan. Address conservation goals and strategies in all other community planning documents.

- Refer to Sections 3 through 6 of the Green Growth Toolbox for specific recommendations on the amount of habitat wildlife need and what land use planning techniques can be used to better conserve habitats and natural resources. This science-based information can help in creating policies that actually conserve priority wild life habitat.

Coordinate with neighboring counties and municipalities.

- Adopt a regional wildlife and habitat conservation resolution to coordinate planning actions, implementation strategies, land acquisition activities, stewardship activities and other conservation actions.

d www.conservationfund.org

When planning for the creation of greenways and trails, consider the needs of wildlife that could also use these greenways as habitats and travel corridors.

- Refer to Section 3 for specific recommendations on designing greenways to conserve priority wildlife habitat.

Encourage setting aside contiguous large core areas of natural open space in developments in sensitive areas. Encourage clustered rural and urban development and agricultural districts to enable conservation of a network of priority habitats.

- Identify which ordinances, programs and other tools could be used to make development patterns less spread out and more centralized in rural developments and in urban areas.
- Schedule when the revisions and ordinances will be drafted and considered by local boards.
- Refer to Sections 3 to 6 for measures to conserve priority wildlife habitat at all levels of land use planning.

Implementation Support

Implementation is the most challenging aspect of planning. Listed below are a few key components that will help to ensure that your plans do not sit on a shelf.

To support implementation activities:

- Include implementation responsibilities in plans, work unit business plans and individual staff work plans.
- Create line items in work unit budgets to provide funds needed to implement conservation strategies.
- Make certain all appropriate staff and elected officials are educated about their roles to ensure successful implementation.
- Develop and publish a list of contacts for conservation partners that can assist in Green Growth planning and implementation (see Appendix B).

Create and Update an Action Plan

Create an implementation action plan that will outline specifically who, what, when, where and how conservation strategies will be implemented. For instance, Orange County, North Carolina, adopts two-year action plans[e] to guide implementation of the strategies outlined in their Lands Legacy Program guiding document.

e https://www.orangecountync.gov/857/Lands-Legacy-program

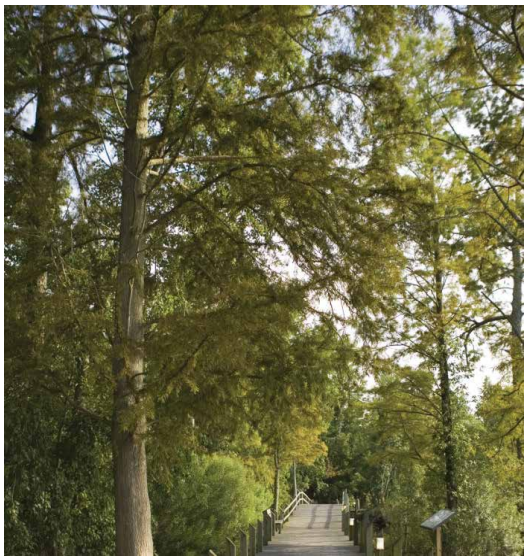
Conservation Advisory Boards

A number of North Carolina communities have conservation related boards. These boards can play an active role in helping your community achieve Green Growth. A conservation advisory board can:

- Inform or guide development of a local conservation plan.
- Work with elected officials, planning staff and the planning board to structure zoning and development ordinances to improve habitat conservation.
- Review development applications and assist developers in creating wildlife friendly development projects.
- Initiate and guide a county-wide natural resource inventory.
- Guide development of management plans for natural areas in the town.
- Work with local land trusts to purchase strategic parcels of land for conservation.
- Consider appointing a staff member with some biological expertise to assist the conservation advisory board in the roles described above.

Land Acquisition and Conservation Easements

- Public education on the benefits and need for land conservation generated public support for conservation funding in York County, S.C.
- Establish funding for transaction or total costs of conservation easements on important natural areas in your community. A conservation easement is a voluntary agreement that allows a land owner to permanently limit the type and amount of development on their property while retaining private ownership.
- Coordinate land acquisition strategies with other jurisdictions to conserve landscapes that may cross your own community's boundaries.
- Develop a partnership with your local land trust to cooperatively work toward conserving high-quality natural areas in your community.
- Encourage your Soil and Water Conservation District to accept and monitor conservation easements.
- Plan for your land acquisition program to obtain strategic parcels of land.



Scuppernong River boardwalk

Examples

Raleigh, North Carolina, has a watershed protection fee[f] on water bills. The fee averages 60 cents per month per family and is used to protect lands important to drinking water quality.

York County Forever[g] is a commission of York County, South Carolina, that funds transaction costs of conservation easements. It is funded by a small proportion of local taxes voted in by the public after a conservation education campaign.

f https://raleighnc.gov/services/water-and-sewer/watershed-protection-program
g http://yorkcountysc.iqm2.com/Citizens/Board/1084-York-County-Forever-Commission

Public Works and Utilities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Native grassland along a powerline

- Integrate wildlife habitat conservation and restoration strategies into existing public works programs (i.e., solid waste programs, water resources programs).
- Incorporate wildlife conservation priorities into transportation facility planning, design, development and maintenance.
- Restore and develop wildlife habitat management plans for community -owned lands, including parks, green ways, natural areas, schoolyards and other open spaces.
- The Wake Nature Preserves Partnership[h] (Wake County, North Carolina) is a good example of collaboration between the county, a university, and natural resource agencies to manage county parks for natural habitat.
- Use native landscaping on municipal and county building sites.
- Work with businesses, government agencies and other groups to reduce bright night lighting and its negative impact on wildlife. This can also save public energy costs.

Incentive Programs

- Create a local recognition or rewards program for landowners or developers who maintain wildlife habitat on their properties.
- Promote wildlife habitat management cost-share programs and tax incentives.
- See Section 5 for more incentives information.
- See the Defenders of Wildlife report, Incentives for Biodiversity Conservation.[i]

Education

Public education about the value of our wildlife and habitats is essential to natural resources conservation at the local level.

- Encourage your newspaper to run a regular wildlife conservation-related column.
- Utilize social media to educate the public about wildlife and conservation issues.
- Work with conservation partners to develop wildlife education programs and facilities to provide opportunities for citizens to learn about the species, habitats, and important ecosystems in your community.
- Provide information to residents and visitors about how to avoid wildlife conflict situations and respond appropriately when they arise (see Appendix C).

h wakenature.wordpress.com

i www.defenders.org/publications/incentives_for_biodiversity_conservation.pdf

INTEGRATING STATE AND REGIONAL CONSERVATION PLANS

Although local governments focus on developing plans for individual jurisdictions, it is important to examine the larger, regional context within which these plans are being created. When putting together a local conservation plan—or a "habitat conservation" section for an existing plan—integrate the goals and strategies of state and regional conservation plans into your local plan.

State and regional plans are important because they can help your community to:

- Analyze the impacts of land use policies in a regional context.
- Leverage the expertise of prior planning efforts.
- Establish a fruitful partnership with state and regional conservation initiatives.

North Carolina Wildlife Action Plan[j]

This plan was developed by the North Carolina Wildlife Commission in partnership with hundreds of stakeholders and wildlife experts across the state. The plan provides science-based information on the wildlife and habitat conservation priorities in our state.

- The plan identifies fish and wildlife species and describes associated habitats that are priorities for conservation.
- Use and reference the habitat descriptions and priority species lists from this plan in planning documents as appropriate.

N.C. Conservation Planning Tool[k]

The North Carolina Department of Environment and Natural and Cultural Resources (NCDNCR) has developed a conservation planning tool.

- This tool consists primarily of six GIS assessments that identify the highest quality lands and waters for conservation across the state. For more information, see **Section 2**.

Regional Conservation Plans

In addition to these statewide initiatives, many conservation planning efforts have been undertaken at the regional level. Regional conservation plans specific to your area are available in your Green Growth Toolbox Regional Appendix. Some links to regional plans are:

- The N.C. Conservation Planning Tool web page on other conservation planning efforts[l]
- The Coastal Habitat Protection Plan,[m] which provides information on the status of marine habitats and coastal fisheries and outlines management needs for threatened coastal resources.
- Basin-wide Water Quality Plans[n] from NCDEQ which contain information about local natural resources conditions.
- Available through your Council of Government and include watershed, green infrastructure, and other conservation related plans.

j www.ncwildlife.org/plan
k https://www.ncnhp.org/conservation/north-carolina-conservation-planning-tool
l www.ncnhp.org/conservation/conservation-planningtool/resources/other-efforts
m https://deq.nc.gov/about/divisions/marine-fisheries/habitat-information/coastal-habitat-protection-plan
n https://deq.nc.gov/about/divisions/water-resources/water-planning/basin-planning-branch

KEY CONCEPTS FOR ENABLING HABITAT CONSERVATION IN PLANNING

It is essential to incorporate conservation goals, objectives and strategies in all types of community plans and to include an implementation action section in all plans. The following are key concepts to address in community plans that will enable wildlife and habitat conservation. Refer also to Handbook Sections 3, 5 and 6 for additional policy ideas.

Land Use Planning *(See example plans on page 75)*

The action that is most important to enable wildlife and habitat conservation in land use planning is to encourage a connected network of priority habitats. Design land use districts and policies to avoid extensive spread out development in high priority habitat areas and to encourage agricultural districts around and between protected lands.

Transportation Planning *(See example plans on page 76)*

Roads have a great impact on the health and stability of habitats and wildlife populations, especially for those animals that move on land such as amphibians and reptiles, but also for species that fly or glide, including bats and flying squirrels.

- Encourage development patterns and resulting road projects that encourage centralized growth and will avoid priority wildlife habitats.
- Take advantage of Federal Highway Administration (FHWA) grant programs for ecological conservation.
- Emphasize "Transit Oriented Development," biking, walking, and public transit
- Avoid wetlands and minimize road stream crossings.
- Encourage roads and developments that are set out in a grid system versus cul-de-sacs and unconnected streets; this allows for compact development and walking.

Wildlife Crossing Structures

Wildlife crossing structures enable wildlife to cross under or over busy roads. These can be placed in areas where major roads bisect high priority wildlife habitats and travel corridors. Wildlife crossing structures are effective in preventing collisions and reducing injuries, deaths and vehicle repair costs. Costs are approximately 8 percent of the road project cost.[4] The N.C. Department of Transportation (NCDOT) consider installing these at locations between permanently conserved lands.

Therefore, it is important to target land acquisition in key areas.

- Request that NCDOT or FHWA fund wildlife road underpasses in your community.
- Collaborate with federal, state and local partners to plan a system of wildlife under passes using programs such as the FHWA Environmental Review Toolkit[o]

For more information on wildlife crossing structures see:

- Federal Highway Administration's Critter Crossings website[p] and *Wildlife Crossing Structure Handbook Design and Evaluation in North America*[q]

o https://www.environment.fhwa.dot.gov/env_initiatives/eco-logical.aspx
p www.fhwa.dot.gov/environment/critter_crossings/main.cfm
q https://www.fhwa.dot.gov/clas/ctip/wildlife_crossing_structures/

Park and Greenway Plans *(See example plans on page 76)*

- Refer to Section 3 and specifically discuss the width and area of habitat needed to conserve priority wildlife habitat and travel corridors with greenways.
- Create a category of public parks that conserve and manage natural habitats with a goal along the lines of connecting the public with nature.
- Set up a method to remain aware of conservation opportunities with willing land owners in priority habitat areas. Work with your land trust.
- When designing parks and greenways try to conserve and manage a connected network of large habitat hubs and wide natural corridors that connect the hubs.

Risk Assessments, Climate Resilience, and Hazard Mitigation Plans
(See example plans on page 76)

Healthy ecosystems, compact development patterns, and wildlife friendly development practices protect our communities from storms, floods, drought, and wildfire. Actions your community takes to conserve wildlife and habitat will reduce the risk of natural disasters.

- Address the importance of supporting prescribed fire on managed areas through land use planning. See pages 4, 30, and 94 for more information.
- Encourage Firewise design and keep intensely developed areas far from large natural areas and working lands.
- Discuss the hazard mitigation benefits of conserving floodplain forests, large and small wetland communities and large blocks of forest (**see Section 1** for benefits).
- Provide incentives to developers to use conservation design and other low impact development techniques to reduce the severity of flooding events.
- Zoning overlays can provide protection to natural areas needed to support community resilience.
- Identify ordinances that could protect natural resources and habitat, **see Section 5** and NC Wildlife Commission's model natural resources conservation ordinance.[r]

For detailed information on how to do Climate Resiliency planning, see:

- N.C. Office of Recovery and Resiliency supports communities in planning to reduce impacts of climate change and recover from hazardous events, www.rebuild.nc.gov/.
- Environmental Law Institute's Wetlands, Wildlife Habitat and Flood Hazards, for guidance on integrating priority habitat conservation in local hazard planning.
- FEMA's Building Community Resilience with Nature-based Solutions: A Guide for Local Communities is a comprehensive guide on integrating conservation, restoration, and green infrastructure in community planning and public works.
- Hudson River Estuary Program's Climate-Adaptive Communities resources[s]
- Great Green Cities[t] summarizes resiliency projects being conducted in many cities.
- NOAA's Naturally Resilient Communities[u] is a guide and training program featuring options, examples, success stories, and case studies.

For Climate Resiliency planning tools for the coast see the **Coastal Appendix.**

r https://www.ncwildlife.org/Conserving/Programs/Green-Growth-Toolbox/Greening-Ordinances#32461101-nc-model-natural-resourcesbrconservation-ordinance
s https://www.dec.ny.gov/lands/39786.html
t www.nature.org/content/dam/tnc/nature/en/documents/Green_City_FINAL_PDF.pdf
u ttps://coast.noaa.gov/digitalcoast/training/nrc.html

Watershed Management Plans *(See example plans on page 76)*

- Address the importance of conserving high-quality streams proactively
- Emphasize conservation of stream buffers - restoration is much more costly than preserving riparian forest buffers to maintain water quality and healthy streams
- Encourage the use of wildlife friendly low impact development and management practices to minimize nutrient, sediment, stormwater and other polluted runoff
- Identify wildlife and habitat conservation priority areas that overlap with watershed priorities

Farmland Protection Plans

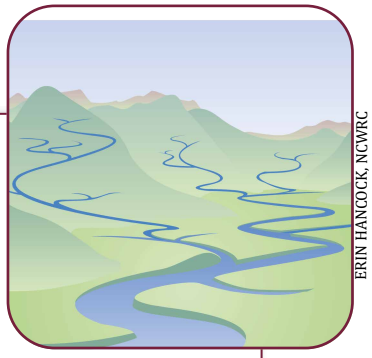
Floodplain forests protect farms

JEFF MARCUS

- Address the importance of farm and for est land as buffers to Managed Areas and as wildlife travel corridors (see page 31)
- Evaluate where priority species that depend on cropland or forest connectivity occur
- Stress the importance of habitat management on working lands and easements
- Address the role of biodiversity in pollination
- Include information about the Wildlife Conservation Lands Program[v] as a mechanism to conserve wildlife habitats on private land

Strategic and Economic Development Plans

- Include information on the benefits of Green Growth from Section 1
- Address the importance of Green Growth practices in maintaining rural, scenic, and nature-related recreation, spending, and tourism.
- Enable wildlife related recreation, including hunting and fishing, through coordinated acquisitions, easements, and land use planning measures
- Recognize the importance of wildlife friendly greenways to economic development
- Address the importance of outdoor nature-related opportunities to attracting new business and skilled workers



ERIN HANCOCK, NCWRC

What is

a watershed?

All land is part of a watershed - where water flows from higher to lower elevations into streams, rivers and, eventually, the ocean. Riparian forest stream buffers are essential to filter and clean water, maintain top soil, trap sediment, and filter polluted runoff. Without riparian forest buffers rainwater runs off directly into streams without being filtered by trees and plants, which increases drought conditions and pollution.

v www.ncwildlife.org/Conserving/Programs/LandConservationProgram.aspx

Green Building and Energy Efficiency Plans

- Encourage conservation of natural, contiguous open space in green building criteria in priority habitat areas
- Address the cost and energy savings that are gained from more centralized development patterns and mixed uses that encourage less driving
- Encourage wildlife friendly site selection for wind and solar facilities

Performance Measures

Performance measures for local government habitat conservation planning include:

- Acres of conserved priority habitat and average habitat patch core area
- Number of cluster developments in each land use district
- Feet of stream buffered by riparian forest and average buffer width
- Water and air quality metrics
- Number of parcels with connected natural open space
- Forest cover using the National Land Cover Database[w]
- Acres of forests or agriculture in Present Use Value
- Acres of land enrolled in the N.C. Wildlife Conservation Lands Program
- The number of planning processes and ordinances that improve habitat and natural resource protection

Examples of Local Government Performance Measures

- Mecklenburg County, North Carolina, State of the Environment Report[x]
- King County Washington Environmental indicators and Performance Measures[y]

Example Plans

Land Use and Comprehensive Plans

- Davidson, NC Rural Area Plan[z] -award-winning example of a plan that upholds conservation as the basis for planning in an area with high development pressure; integrates Green Growth Toolbox habitat recommendations.
- Town of Navassa, NC, CAMA Land Use Plan[aa] - provides an example for a rural community near a major city.
- Madison County, NC Comprehensive Plan[ab] - is an example of how a rural community chose to incorporate green growth principles.
- Randolph County, NC, Growth Management Plan[ac] - emphasizes a vision and practical goals to conserve natural heritage through cluster development. It also lays out techniques to allow for higher density development, once public water and sewer are available on previously developed sites.
- Raleigh, NC, 2030 Comprehensive Plan[ad] - integrates wildlife and habitat conservation and compact development strategies in all planning elements. Section 5, 'Environmental Protection,' provides detailed priority wildlife habitat

w http://www.mrlc.gov
x https://www.mecknc.gov/LUESA/sustainability/Pages/GoalsandProgress.aspx
y https://kingcounty.gov/services/environment/data-and-trends/indicators-and-performance.aspx
z http://www.townofdavidson.org/DocumentCenter/View/7264/20160902-Davidson-Rural-Area-Plan-Low-Res?bidId=
aa https://townofnavassa.org/images/planning_zoning/Future_Land_Use_Plan_201174376.pdf
ab https://www.madisoncountync.gov/uploads/5/9/7/0/59701963/madison_county_ comprehensive_plan.pdf
ac https://www.randolphcountync.gov/236/Growth-Management-Plan
ad https://raleighnc.gov/planning/2030-comprehensive-plan

conservation information, justification, goals and strategies.

- Orange County, NC, Comprehensive Plan,[ae] Section 6.4.4 - contains a description of the county's wildlife and plant resources and establishes conservation strategies.
- City of Tampa, FL, Comprehensive Plan,[af] Chapter 5, 'Sustainable Environment,' includes a rationale, goals and policies to conserve significant wildlife habitats. The plan's policies are further implemented through the city's Upland Habitat Protection Ordinance and Urban Environmental Coordinator.

Transportation Plans

- McHenry County, Illinois, Long Range Transportation Plan[ag] is based on a Green Infrastructure plan and maps that include important wildlife habitat areas.
- Arizona Department of Transportation Wildlife Linkages Assessment[ah] was created in consultation with wildlife professionals to identify key areas for wildlife underpasses and to minimize road construction.

Watershed Management Plans

- Lincoln County, North Carolina used the Green Growth Toolbox and the N.C. Conservation Planning Tool in the Indian Creek and Howards Creek Local Watershed Plan.[ai]

Greenway Plans

- The Westmoreland County, Pennsylvania, New Horizons: A County-wide Greenways and Blueways Network,[aj] plan uses habitat conservation data to identify a network of large habitat hubs and corridors. Strategies, land use methods and funding mechanisms to conserve the network are discussed.

Climate Resiliency, Risk Assessment, and Hazard Mitigation Plans

- Blacksburg, Virginia's Climate Action Plan[ak] emphasizes the need for forest protection in order to meet its climate goals.
- Nature-Based Coastal Flood Mitigation Strategies City of Virginia Beach, Virginia, prioritizes restoration of natural ecosystems to address flooding issues associated with sea-level rise.
- Albany, New York's Comprehensive Plan's Climate Action Plan[al] identifies the protection of natural areas as a critical resiliency strategy.
- Oakland, California's Equitable Climate Action Plan[am] provides a model for effective climate resiliency planning that prioritizes equity, inclusion, and justice as the centerpiece of its engagement and action. The Adaptation chapter focuses on nature-based solutions.

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ae http://www.orangecountync.gov/1238/Comprehensive-Land-Use
af www.planhillsborough.org/tampa-comprehensive-plan/
ag https://www.mchenrycountyil.gov/county-government/departments-j-z/transportation/transportation-plans/long-range-transportation-plan
ah https://azdot.gov/business/environmental-planning/programs/wildlife-linkages
ai http://www.lincolncounty.org/DocumentCenter/View/1997/080210Item7?bidId=
aj www.dcnr.state.pa.us/cs/groups/public/documents/document/d_001213.pdf
ak https://www.blacksburg.gov/home/showpublisheddocument?id=5773
al https://www.albanyny.gov/DocumentCenter/View/3524/2012---Albany-Climate-Action-Plan-Albany-2030-Plan-Appendix-D-PDF?bidId=
am https://cao-94612.s3.amazonaws.com/documents/Oakland-ECAP-07-24.pdf

Wildlife and Biodiversity Conservation Plans

- Village of Schaumburg, Illinois, Biodiversity Recovery Plan[an] is part of their Comprehensive Plan. It guides the community's efforts to preserve, restore, and maintain biodiversity within the community.
- Anchorage, Alaska's municipal Comprehensive Wildlife Management Plan[ao] was developed in partnership with multiple state and federal agencies.

Local Government Green Infrastructure Programs

- The Piedmont Triad Regional Council created a Green Infrastructure Plan[ap] for its whole region.
- The Conservation Fund is one organization that maintains a website of local government green infrastructure case studies.[aq]

Regional Comprehensive Assessments

- The Western North Carolina Vitality Index[ar] provided information on the status of the economic, social, natural, and built environment indicators of 27 counties in western North Carolina. It incorporated the N.C. Conservation Planning Tool and summary information on the biodiversity resources of the region.
- GroWNC[as] was created by the Land of Sky Regional Council and is based on planning that will increase economic competitiveness and job creation in the Council's region of the southwest North Carolina mountains. It incorporates a green infrastructure analysis and scenario mapping for development patterns and natural resource conservation.

Multiple Examples of Wildlife Conservation-Based Planning and Development

- See the Minnesota Department of Natural Resources Guide to Using Natural Resource Information in Local Decision Making.[at]

For More Information and Resources

American Planning Association. 1999. Policy Guide on Endangered Species and Habitat Protection. Available from: https://www.planning.org/policy/guides/adopted/endanger.htm

Austin et al. 2004. Conserving Vermont's Natural Heritage: A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Waterbury, VT. Available from: www.vtfishandwildlife.com/cwp_home.cfm.

Chicago Wilderness Consortium. 2007. Chicago Wilderness Biodiversity Recovery Plan. Available from: https://cdn.ymaws.com/www.chicagowilderness.org/resource/resmgr/

an https://www.villageofschaumburg.com/home/showpublisheddocument/1212/637191666230000000#:~:text=The%20Schaumburg%20Biodiversity%20Recovery%20Plan,the%20context%20of%20the%20Village.
ao https://www.adfg.alaska.gov/index.cfm?adfg=anchoragewildlifeplanning.anchorage2#relation
ap https://www.ptrc.org/home/showpublisheddocument/7240/636621452741970000
aq https://www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/case-studies/index.php?option=com_content&view=article&id=539&Itemid=160
ar www.wncvitalityindex.org
as http://www.landofsky.org/pdf/LGS/GroWNC/GroWNC_Regional_Plan_Final_small.pdf
at www.dnr.state.mn.us/nrig/index.html

Publications/biodiversity_recovery_plan.pdf

Corridor Design: GIS Tools for Designing Wildlife Corridors. [Internet]. Available from: http://corridordesign.org

Duerksen, C. and C. Snyder. 2005. Nature-Friendly Communities: Habitat Protection and Land Use Planning. Island Press: Washington, DC.

Elliott, D. L. 1998. Planning and Development for People and Wildlife, American Planning Association.

Maine Department of Inland Fisheries and Wildlife. 2003. Beginning with Habitat: An Approach to Conserving Maine's Natural Landscape for Plants, Animals and People. Available from: www.beginningwithhabitat.org.

Minnesota Department of Natural Resources. Guide to Using Natural Resource Information in Local Decision Making. [Internet]. [Cited Dec 2012]. Available from: www.dnr.state.mn.us/nrig/index.html#.

Perlman, D.L. and Milder, J.C. 2005. Practical Ecology for Planners, Developers and Citizens. Lincoln Institute of Land Policy. Washington DC: Island Press.

White, P. A. and M. Ernst. Second Nature: Improving Transportation Without Putting Nature Second. Washington D.C: Defenders of Wildlife. Available from: https://escholarship.org/content/qt45b3r257/qt45b3r257.pdf#

1 Hedley, S. G., K. A. Wilson, A. Moilanen, T. Rebelo and H. P. Possingham. 2009. Delaying conservation actions for improved knowledge: how long should we wait? Ecology Letters 12:293 – 301.

2 Perlman, D.L. and Milder, J.C. 2005. Practical Ecology for Planners, Developers, and Citizens. Lincoln Institute of Land Policy.

3 These suggestions are drawn from several sources cited under 'For More Information' in this section: Chicago Wilderness Consortium (2007), Austin et al. (2004) and Maine Department of Inland Fisheries and WIldlife (2003).

4 Bank, F. G., C. L. Irwin, G. L. Evink, M. E. Gray, S. Hagood, J. R. Kinar, A. Levy, D. Paulson, B. Ruediger, R. M. Sauvajot, D. J. Scott, and P. White. 2002. Wildlife habitat connectivity across European highways. U. S. Department of Transportation Federal Highway Administration Report: 1-45.

5 Knight, Andrew T., Cowling, R.M., Campbell, B.M. 2006. An Operational Model for Implementing Conservation Action. Conservation Biology, 20(2), 408-419.

U.S. FISH & WILDLIFE SERVICE

ACHIEVE GREEN GROWTH THROUGH INCENTIVES AND ORDINANCES

Communities around the country have developed ordinances with the goal of protecting important wildlife habitats. However, research by the University of Colorado has shown that most ordinances lacked measures to minimize habitat fragmentation, a leading cause of wildlife declines.[1, 2] In addition, many ordinances also do not sufficiently define wildlife habitat, so habitat cannot be consistently identified or actually conserved.

Habitat fragmentation from development patterns is *the* leading cause in current declines of most of the over 450 wildlife Species of Greatest Conservation Need in our state. Green Growth emphasizes growth management incentives and ordinances that remove barriers to wildlife habitat conservation. We encourage local governments to focus on reducing wildlife habitat fragmentation.

How to Use This Section

Please use the NC Model Natural Resources Conservation Ordinance as your primary guide to NC Wildlife Commission recommendations for conserving wildlife habitat through ordinance language. The other example ordinances are intended to provide options for approaches and language to help you tailor your community's ordinance and not as a comprehensive way to achieve effective wildlife habitat conservation.

This Section can be used as a checklist of recommendations for local ordinance updates. However, Green Growth Toolbox program staff are available to review ordinances and recommend specific changes.

What about **climate resilience ?**

Any of our Greening Ordinances recommendations will improve community climate resilience and are "nature-based solutions." Ordinance updates using the GGT may qualify for climate resilience grant funds.

Please see page 92 for a visual representation of a landscape that accommodates development, wildlife habitat, and natural resource conservation.

Reduce Wildlife Habitat Fragmentation

Source: 1000 Friends of Florida, Benjamin Pennington

Many local governments nationwide have ordinances that require or encourage habitat conservation. However, these policies are failing to prevent habitat loss because they do not clearly state that wildlife habitat should remain unfragmented. To prevent fragmentation, the habitat interior to edge ratio should be minimized by being as close to circular, without perforation, and as large as possible. Natural open space on adjacent developments should be connected so that a connected network of natural areas can be formed. Private or public greenways or trails can be placed in connected natural open space.

How to Use This Section (cont.)

To justify ordinance updates it is important to know the economic and other benefits. Use Section 1 and the Benefits of Green Growth factsheet[g] available on our website to inform decision makers about the economic and health benefits of Green Growth.

Use Section 2, Conservation Data, to understand where priority habitats are located in your community. Require applicants to display specific map layers from the Conservation Data in maps used for rezoning and development approval. Craft habitat conservation measures in ordinances that refers to and defines the Conservation Data layers.

To understand design and development standards ordinance language for sufficient habitat conservation, see Section 3, Wildlife Habitat Conservation Recommendations.

Principles for Greening Ordinances

Maintain land use patterns that do not fragment wildlife habitat, that do maintain rural character, and conserve, buffer, and connect priority wildlife habitats.

In existing urban & suburban areas, encourage high density development, mixed uses, transit oriented development, and low impact development stormwater measures. Implement a Conservation Incentive District that buffers and connects streams, floodplains, and wetlands. Generally, encourage development of upland (non-wetland) areas not depicted on the NC Biodiversity & Wildlife Habitat Assessment. Infill development and major development that does not expand the suburbs out into rural areas, is best for wildlife.

I***n rural areas,*** encourage rural land uses that ensure the vitality of keep forestry and farming. Any development should be clustered with mostly smaller lot sizes (a variety of lot sizes can be accommodated), consider implementing a Conservation Incentive District that conserves all habitat types (page 94).

g www.ncwildlife.org/Portals/0/Conserving/documents/GGT/Benefits%20of%20Green%20Growth.pdf?ver=LjAbTs-15KLkbQR41Nm9cg%3d%3d

Conventional Subdivision - Uses minimum lot size and offers no density bonus

Farmland, grassland habitat and historical site are lost.

Conservation Subdivision - Uses development units per acre, allows density bonus, & a variety of lot sizes

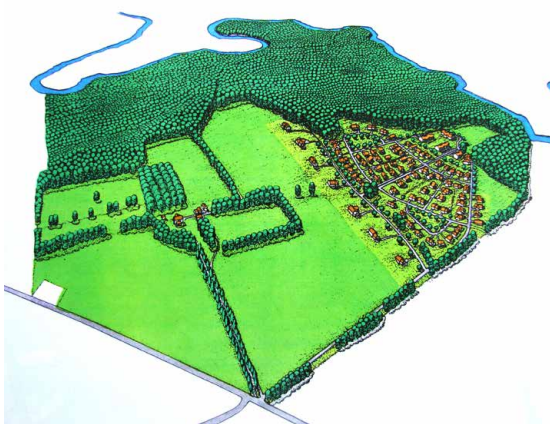

Image courtesy of Randall Arendt, from Arendt, R., M. Collins, and A. Valentine (1996). Open Space Design Guidebook: Albemarle Pamlico Estuarine Region. Prepared for the North Carolina Association of County Commissioners. Media, PA, Natural Lands Trust.

GREENING INCENTIVES

Incentives are important for creating development patterns and practices that maintain wildlife habitat and natural resources. Here, we summarize the incentives available in North Carolina and also some popular incentives used by other states, but which may require approval from our State Legislature to implement.

Development density bonuses: Develop more units on less land and offer a variety of lot sizes

To encourage habitat conservation and habitat connectivity in subdivisions, many community ordinances featured in this section offer a density bonus in exchange for conservation of over 40% of the site.

Permanent Conservation and Ownership of Conservation Areas

A variety of entities can own conservation areas associated with developments, including developers, or homeowner's associations. The land can sometimes be donated to a land trust or other entity. It is essential that the land is permanently conserved by the strongest legal tools available.

bog turtle

Conservation Easements

A conservation easement should be placed on natural open space in conservation developments. If that is not possible, there are other less secure ways to conserve natural open space on site.

Under a conservation easement the landowner retains full ownership of their property. Conservation easements are voluntary legal agreements that permanently protect land from intensive development. Landowners can donate conservation easements to an easement holder, usually a land trust. An easement donation can offer significant tax reduction cost savings to landowners. Conservation measures in the easement are negotiable and

match the landowner's property-use objectives and needs with long-term benefits to their community. Local governments can greatly support the ability of landowners to utilize conservation easements by creating funding mechanisms to finance legal and real estate transactions fees for conservation easement projects led by land trusts. Local governments and Soil and Water Conservation Districts can also hold conservation easements. Target easement projects to the highest priority wildlife habitat and natural resources.

Find your local land trust at www.findalandtrust.org.

For examples of local government support of conservation easements, see Section 4, page 69.

If a conservation easement is not possible:

Placing high priority habitats in commonly-owned open space is technically possible without a conservation easement. The homeowner's association can own the land and fund habitat management. Developers can also donate conservation land to local governments or other entities. Deed restrictions offer a minimum of habitat conservation assurance, but are better then no legal documentation.

Other incentives

- Priority development review and personal assistance to expedite permitting.
- Awards and certification for developers that avoid sensitive natural areas and minimize urban sprawl including:
  - The Wildlife Friendly Development Certification program (developer application fee required) certifies qualifying developments.[h]
  - LEED certification (developer application fee required), particularly the LEED Neighborhood Development Certification.[i]
  - The Greater Triangle Stewardship Development Awards program is a local awards program for developments that show outstanding environmental stewardship.[j]

A Note on Property Tax Incentives Programs in NC

Land used for wildlife habitat, farming, and/or forestry may be eligible for tax incentives that reduce a landowner's property tax burden. Land eventually converts into the use for which it is taxed. Working lands do not require residential public services and will likely convert to that tax rate without tax-relief, so the following programs are very important to maintain strong rural communities, wildlife, and natural resources we depend on. We recommend that local governments provide information to landowners about the following incentives. Consider featuring the following programs on your local government's website.

The Wildlife Conservation Lands Program (WCLP)

This program enables landowners to receive a reduced property tax rate for conserving and managing wildlife habitat. Landowners must have owned their property for at least four years, have at least 20 acres of habitat, and use the land for wildlife habitat.[k]

Agricultural and Forestry Present-Use Value

Landowners with an approved forest management plan or a working farm can qualify for a reduced property tax rate. Refer to:

h www.ncwildcertify.org
i www.usgbc.org/leed
j www.gtsda.org/
k www.ncwildlife.org/Conserving/Programs/Land-Conservation-Program

- NC forest Service Present-Use Value Program for Forestland[l]
- Voluntary Agricultural Districts encourage agricultural land uses.[m]

Comprehensive Incentive-based Growth Management Programs

For the most threatened unique ecosystems, especially those with threatened and endangered wildlife (such as areas of intact longleaf pine forest), encouraging extensive land development will not conserve high priority wildlife or habitats. In this scenario, a combination of public and private land acquisition investments and policy that supports managed regional growth has been shown to work. The following types of programs have demonstrated success in this regard but may need approval by the NC Legislature.

Voluntary Transfer of Development Rights (TDR)

Twenty states have passed legislation that enables TDRs,[3] including Georgia and Tennessee. Two hundred such programs exist in the country.[4] Willing landowners can choose to enroll their land as a development rights sending area that contains environmentally sensitive resources and agricultural areas the community wants to maintain. Voluntary development receiving areas are where higher density development is desired, such as in areas needing urban renewal.

The TDR program then facilitates transactions where willing landowners in the sending area sell development rights to developers in the receiving area who desire increased development density. A successful TDR Program takes careful steps not to disenfranchise landowners and to set baseline densities that create a development density purchase incentive.

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l http://ncforestservice.gov/Managing_your_forest/managing_presentuse.htm

m www.ncagr.gov/Farmlandpreservation/VAD/

Voluntary Transfer of Development Rights

MCSWEEN PHOTOGRAPHY

Example TDR Programs

- King County, Washington's TDR Program has preserved the most wildlife habitat of any TDR program (92,000 acres, 2000 - 2022), while accommodating growth.[n]
- Montgomery County, Maryland's TDR Program was established to preserve farmland and to curb sprawl originating from Washington D.C.[o]

The Rural Lands Stewardship Program (RLSP)
A non-regulatory, market-driven, incentive program led by landowners

Although the results of the RLSP program have been mixed, this framework is a promising approach. The RLSP was spearheaded by Collier County, Florida[p] and offers landowners of large acreage property an incentive-based solution for growth management in Florida. The program can serve communities nationwide. In 2004, the Florida legislature enabled this innovative approach. It is not a TDR program, but a credit-trading program whereby willing landowners and developers trade credits to conserve valued natural resources, including wildlife habitat. The effectiveness of Florida's program to truly conserve natural resources and wildlife habitat is still in question, however. Some outcomes may lead to scattered urbanization in rural areas, which fragments habitat.[4] The program was deemed a success by Collier County, who still employs it and plans to improve it to address problems. The lack of parity between Florida State Land Use Planning rules and the RLSP has prevented adoption by other counties to date. See https://rlsafacts.com for full details.

Regional Commissions

The Pinelands of New Jersey is an interesting case study for how to achieve conservation of large landscapes of unique habitat under significant development pressure. The New Jersey Pinelands Commission[q] provides growth management incentives to participating communities. The Pinelands Commission also monitors the economic health of the region. Pinelands communities consistently issue more building permits than other areas of the state and have a 4 percent higher median sales price. Building transactions during the economic recession beginning in 2007 were 50 percent higher in the Pinelands and the unemployment rate was the same as other areas.[5]

n https://kingcounty.gov/services/environment/stewardship/sustainable-building/transfer-development-rights.aspx

o https://montgomeryplanning.org/planning/agricultural-reserve/transferable-development-rights/

p www.colliercountyfl.gov/government/growth-management/divisions/planning-and-zoning-division/comprehensive-planning-section/rural-lands-stewardship-area/rural-lands-stewardship-area-history-and-archive

q http://www.state.nj.us/pinelands

Reduce Unnecessary Fragmentation and Impacts to Priority Wildlife Habitats

Create and rework existing ordinances to make better use of open space by reducing habitat fragmentation and unnecessary habitat impacts.

Green ordinances:

- Direct development to existing towns and cities.
- Direct extensive development away from the boundaries of Managed Areas (See page 33). Maintain a rural landscape and priority habitat between Managed Areas.
- Conserve a network of large, connected priority habitats represented in the Conservation Data. Larger core habitat areas can be conserved among different connecting parcels and are linked by wildlife travel corridors. Encourage or require connection of large blocks of natural open space on adjacent developments.
- Can be crafted over time. Take any steps toward Green Growth that your community supports.
- Clearly state in the ordinance *Intent and Purpose* the objective(s) from the comprehensive land use plan that are being implemented.
- As much as possible, this section is organized in the order of a typical unified development ordinance so it can be used more easily to update land use ordinances.

It is important to coordinate with other community departments, such as environmental health or fire and rescue, to ensure that their requirements do not unnecessarily compromise habitat conservation and connectivity.

A Model Natural Resources Conservation Ordinance for North Carolina

The N.C. Wildlife Commission and the Duke Nicholas Institute for Energy, Environment, and Sustainability teamed up with the Town of Navassa, N.C., to provide a model ordinance for comprehensive natural resource and habitat conservation in North Carolina communities. The model ordinance acts as an overlay district and is meant to conserve only the most sensitive natural resource areas and the most rare types of upland wildlife habitats. The model language in this ordinance can be used to reduce habitat impacts in any local ordinance.
Please see www.ncwildlife.org\greengrowth for details.

* This model ordinance can be used in any ordinance to define habitat types and standards to conserve and connect habitats.

Importance of a Conservation Incentive District and Conservation Subdivisions

One of the most effective things a community can do to conserve a contiguos connected network of habitat is to have a Conservation District or Conservation Incentive District. If creating a new district is not practical in the near future, make sure your community has a conservation subdivision option that avoids habitat fragmentation.

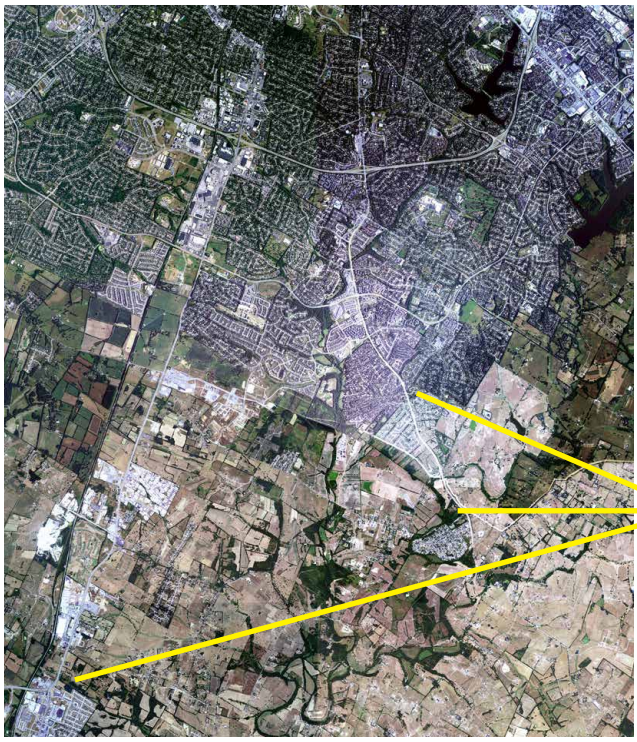
Employ Urban Service Areas to Reduce 'Sprawl'

The primary threat to priority wildlife habitat, farming, and forestry is extensive development spreading haphazardly into rural areas. An Urban Service Area (USA) is a mapped line within which urban services are provided and expanded regularly to meet development demand. Over 100 U.S. cities, counties, and states, including Tennessee have USAs.[6]

- Proper USA management coupled with other planning methods can help direct growth to city centers, curbing sprawl outside the urban fringe.[7]
- USAs maintain rural areas only if the county also uses them.[8]
- Other growth management mechanisms, such as minimum density requirements and transfer of development rights, are used in concert with the USA.[9]
- If drawn to exclude areas with important natural resources of high ecological value, a USA can help your community implement Green Growth.

Example Urban Service Areas

- Fayette County and towns and Lexington, Kentucky, were the first jurisdictions in the U.S. to implement a USA in 1958. They still use this growth management tool, which has resulted in less sprawl than is found in comparable cities.



An Aerial View of Lexington, Kentucky

An aerial view of southeastern Lexington, Kentucky (National Agriculture Imagery Program, 2012) demonstrates the centralized growth pattern and agricultural conservation. This has resulted from the use of an Urban Service Area put in place and expanded since 1958. Notice the centralized pattern of development of other towns due to municipal and county USA policies.

Examples:

- The Orange County, NC, Rural Buffer defines the extent of urban services provided. Joint planning among Chapel Hill, Orange County, and Carrboro helps manage growth using this approach.[g]

g https://cwp.org/wp-content/uploads/2018/02/Orange-Countys-Rural-Buffer-REV.-3.13.19.pdf

Implications of Urban Service Areas

Research has shown that USAs do not affect housing affordability and land values, or deter growth if the Urban Service Area is expanded in time to meet rising development demand.[10] Effective growth management policies do appear to significantly lower public service and infrastructure costs to taxpayers.[11] If insufficient housing or an overstock of commercial or industrial land is allowed within the USA, this can be a disadvantage to neighboring towns left with too much housing, fewer local jobs, and less tax revenue.[12]

Considerations for Zoning

Done correctly, zoning a jurisdiction based on the suitability of the land to accommodate different land uses can protect natural resources, public health, and the economy. However, various conventional development practices, such as mid-density residential development with a 1 to 3 acre minimum lot size, fragments habitats, degrading the network of natural areas on which our communities depend.

Natural resource-based zoning:

- Manages growth patterns by using development units per acre instead of minimum lot size to encourage development clustering.
- Bases the location of zoning districts on an analyses of the Conservation Data and maps presented in Section 2, in addition to the common considerations.
- Maintains healthy streams and wetlands and encourages development patterns and standards that conserve upland priority wildlife habitats.
- Encourages quality, high density, development in towns and cities, near existing urban services and public transportation and away from sensitive areas.
- Encourages rural and urban cluster development.
- Maintains a rural landscape around and between permanently conserved lands.

Make high density development as easy as possible in towns and cities.

- However, avoid placing high density developments in or near priority wildlife habitats mapped in the Conservation Data.
- Focus on crafting a conservation district (See page 94) that conserves and connects forests along streams, rivers, and wetlands.
- In towns and cities, only allow conservation subdivisions in conservation districts and not other districts, so that they do not occur in areas without sensitive resources. It is better to build high density development in areas without priority habitats in towns and cities to prevent 'sprawl.'
- In towns and cities, upland areas without endangered species, even if they look natural, should usually be developed to prevent development spreading out into rural areas. Consult with a wildlife biologist to review your plans and ordinances.

Make any conservation-based development use 'by-right', to reduce permitting barriers.
Make con ventional development methods a special use in sensitive areas.

- Employ 'town-center' mixed uses to provide housing near retail and services to residents. Utilize minimum density requirements for these developments. Aesthetically pleasing high density shopping areas, where people can sit outside, make more income in sales and rent than box store strip mall retail areas. [13]
- Use Transit Oriented Development where high density neighborhoods are close to high-quality public transportation, to ensure ridership.

Ensure that rural areas maintain character and natural resources.

In rural districts:

- Zone by development units per acre instead of minimum lot size (See page 83). This allows development units to be clustered.[14]
- Employ a Conservation District or Conservation Incentive District (See page 94).
- Remove permitting barriers by making clustered and conservation development a 'by-right' development permit. This removes additional development review and saves the developer and planning department time. Consider making larger lot developments a conditional use.
- If development is desired near sensitive habitats, encourage low density clustered rural subdivisions of one dwelling per four or more acres.[15]
- Even large lot zoning of 10 acre minimum lot sizes can fragment habitat for "area-sensitive" wildlife, including most forest dwelling birds, amphibians, and reptiles and some mammals like bobcats and black bear.[16] Development densities of one development unit per 25 acres can lead to the loss of certain bird species from the area.[17]
- Zone districts with the most important habitats and wildlife corridors for agricultural uses and very low overall density. To lower impacts to the most threatened priority wildlife species in North Carolina, more than 25 acres per dwelling unit will be needed.[18, 19, 20] This density could be justified in highly sensitive areas and could meet demand for working lands and wildlife-related recreation.
- Consider using feature-based density described in Section 1.3 of New Hampshire's Innovative Planning Techniques guide. This approach excludes important habitats in the net site acreage in order to better conserve habitats.[h]

Recommendations for Rezoning:

- Require a sketch / concept plan and a pre-application meeting with the planning department, ahead of expensive design. NC local governments such as Randolph, Moore, and Chatham Counties and many others have done this. Developments can be approved more quickly because developers understand the development and design standards ahead of time.
- Require that developers show the Conservation Data on maps and in their concept plan, address how they will minimize impacts to priority habitats. This reduces unnecessary impacts to habitats and the benefits that natural areas provide to residents and the community.

h www.nh.gov/osi/planning/resources/innovative-land-use-guide.htm

Examples and other resources:

- A similar program to the GGT, the Hudson River Estuary Program (NY), has a guide dedicated to conservation zoning.[i]
- Natural Resource Protection Zoning.[j] These districts have no underlying zoning and are designed to be very low density and specifically to conserve sensitive resources applying the principles outlined above. This method was developed in Massachusetts by working with private landowners. This approach was used for many years by local governments. In 2021, it was enacted statewide as part of an economic growth legislative package.
- During the zoning process, Pasco County , FL[k] require coordination with state and federal wildlife agencies to conserve habitat on all development sites where listed species are documented (Section 802).

Climate resilience

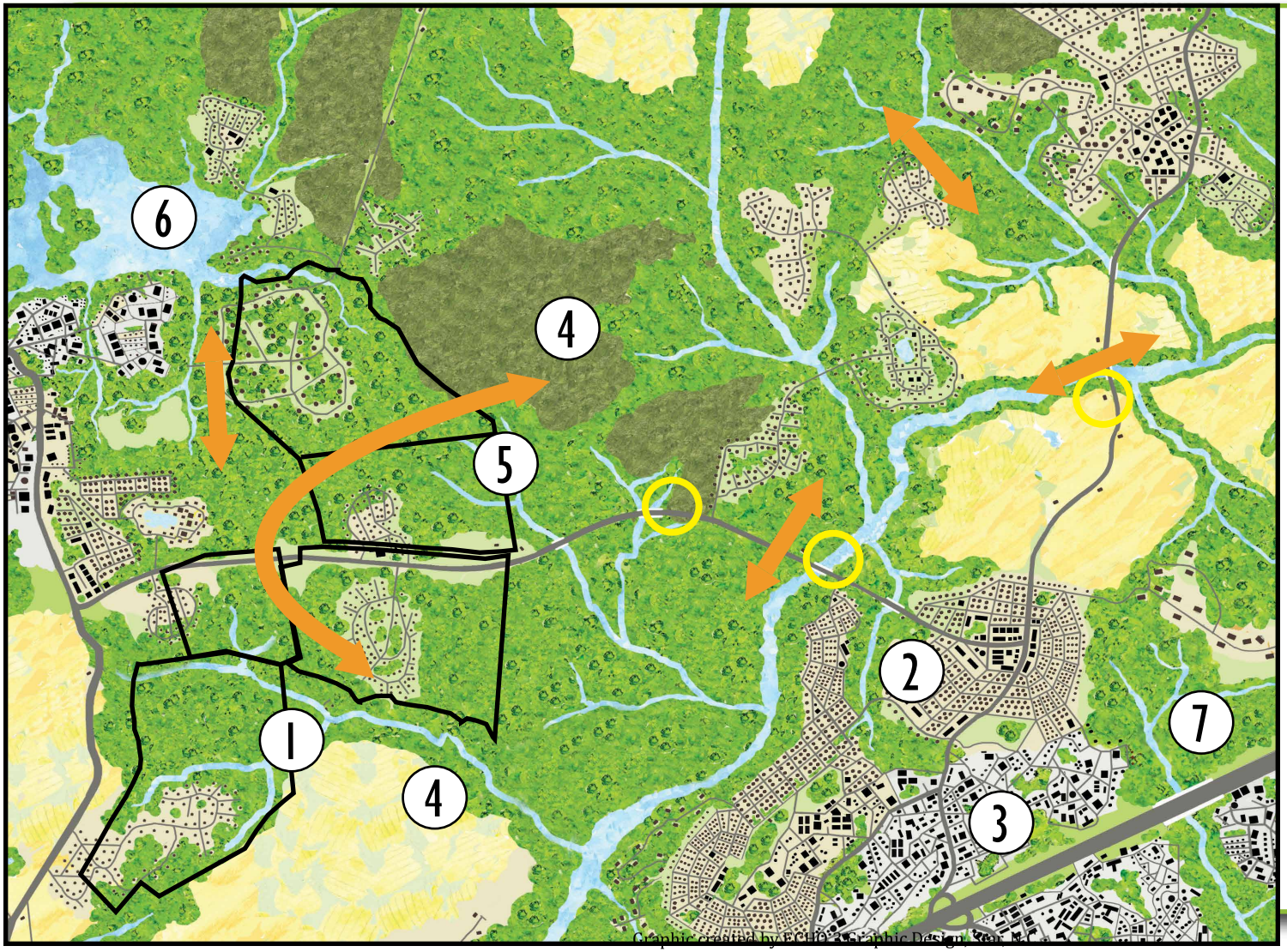
- The City of St. Augustine, Florida has a simple Conservation Overlay Zone ordinance (Chapter 11, Article II) that includes areas that flood every 10 years.[l]
- Georgetown University Law School Climate Center maintains a web page focused on resilient zoning and overlays[m] that includes example local government ordinances and model ordinances.
- Smart Growth Fixes for Climate Adaptation and Resilience, U.S. EPA[n]
- Wetlands Watch Resilient Zoning[o]

Table of Uses

List major subdivisions and other major development types such as Planned Use Developments, as a land use in the Table of Uses and consider permitting them only in districts where major development is appropriate. See the Moore County, NC Unified Development Ordinance Table of Uses as an example of this.

i https://www.dec.ny.gov/docs/remediation_hudson_pdf/overlayzones.pdf
j www.mass.gov/doc/smart-growthsmart-energy-slideshowsopen-space-design-osdnatural-resource-protection-zoning-nrpz/download
k https://library.municode.com/fl/pasco_county/codes/land_development_code
l https://library.municode.com/fl/st._augustine/codes/code_of_ordinances
m www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/zoning-and-overlay-zones.html
n www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience
o https://wetlandswatch.org/resilient-zoning

Efficient, Natural Resource-Based Land Use Pattern



Large, connected priority habitat areas, working lands and other natural resources are secure with an efficient land use pattern.

1. Rural cluster developments conserve large areas of habitat that are connected to habitat on adjacent parcels.
2. Walkable communities are more compact and near commercial uses.
3. Industry and box retail commercial are located near highway junctions for prime vehicle access and less impact.
4. Farms and working forests are not threatened by development encroachment.
5. Small wetland upland habitat buffers are conserved among parcels.
6. Bald eagle nest and waterbird nesting colony buffers are conserved.
7. Stream and river forested buffers of 100 to 300 feet are in place. The floodplain is undeveloped. Greenways are extensive.

Graphic created by [illegible] Graphic Design, [illegible] NC

Bridges are designed as wildlife underpasses and retain non-flooded land for passage.

Residential

Commercial / Industrial

Wildlife Travel Corridors

Native Forest

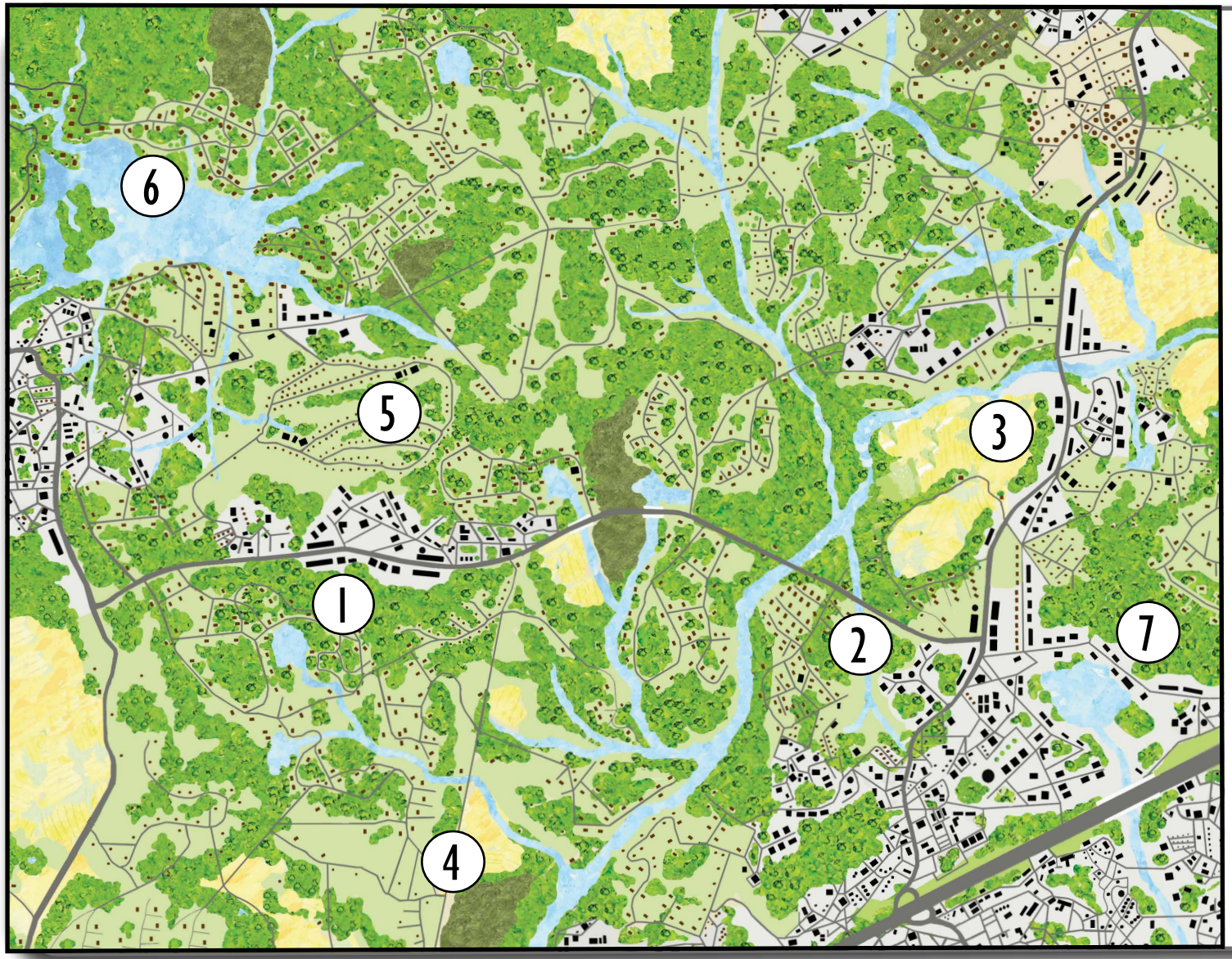
Farms

Lawn

Streams, Rivers & Reservoirs

Working Forests

Inefficient Land Use Pattern that Weakens Natural Resources



The same amount of development is pictured here. Habitat loss has occured due to fragmentation. More roads and spread-out sewer lines cost taxpayers more for maintainance.

1. Rural areas have become suburban sprawl. Intermittent streams are stormwater ponds that reduce groundwater recharge.

2. Communities are not walkable and are far from commercial uses.

3. Industry and box retail commercial sre not strategically located, leading to urban decay.

4. Farms and working forests are lost and threatened by development encroachment.

5. Wetlands are surounded by roads and do not have sufficient upland forest buffers.

6. Bald eagles and wading birds are uncommon.

7. Streams and rivers have minimal to no forested buffers. The floodplain is developed. Drought and flooding increase.

Graphic created by ECHO 3 Graphic Design, Star, N.C.

Bridges do not allow for terrestrial wildlife passage. Priority wildlife and natural resources are threatened.

Craft a Conservation Incentive Overlay or District

In areas not appropriate for extensive development, such as those with an existing network of the highest priority wildlife habitats and wetlands, consider a natural resources overlay district with goals and standards focused on conserving, buffering and connecting habitat. Other intensive land uses can be conditional or not permitted in a conservation district.

Model Ordinance:

- We recommend using the NC Model Natural Resources Conservation Ordinance (page 87). This model ordinance provides the mapping process and model language needed in NC to legally conserve habitats in a conservation district or conservation subdivision. The model also defines NC priority habitat types, which many ordinances do not include, but need to, in order to effectively conserve declining habitat. There are two versions of the model ordinance. One has mandatory language and one is an incentive-based ordinance.

Other Examples:

- Hillsborough County, FL[p], maintains a map of "Significant Wildlife Habitat" (SWH) and requires development conserve up to 50 percent of SWH. They also zone by units per acre instead of minimum lot size and require a state and federal wetlands permit before a building permit is issued. Search the term 'Significant Wildlife Habitat' in their ordinance to find the language.
- *Habitat corridors* - Pasco County , FL require conservation of mapped Ecological Corridors (Section 803)[c]. They offer a range of development options including density bonuses and density transfer on and off-site to avoid impacts to mapped Ecological Corridors. Please note the wetland buffers are not sufficient for habitats in NC.
- The Town of Brunswick, ME, Wildlife Habitat Overlay District[q] discourages habitat fragmentation and creates incentives to maintain contiguous blocks of natural open space during development.
- The King County, WA Code is very comprehensive. Their Critical Areas Ordinance (Title 21 Zoning, Section 21A.24.500)[r] requires protection of Wildlife Habitat Conservation Areas, for wildlife species listed as priorities in the Comprehensive Plan.
- Summit County, CO is another comprehensive example. Their Wildlife Habitat Overlay District (Section 4200)[s] can be seen on their GIS map and seems effective at reducing wildlife habitat fragmentation.

Reduce Habitat Impacts in Development Ordinances and Standards

Recommendations for Development Review

- Consider appointing a natural resources board of people with a natural resources background to review ordinances and provide guidance to the subdivision review board. Many local governments across the country now do this.
- More and more local governments in NC are requiring that applicants demonstrate that they have received state or federal environmental permits ahead of construction. This ensures that building permits are not issued to developments that will

p www.hillsboroughcounty.org/en/businesses/zoning/land-development-code
q www.brunswickme.org/229/Planning-Development
r https://kingcounty.gov/council/legislation/kc_code.aspx
s www.summitcountyco.gov/937/Development-Regulations

On-Site Development Patterns that Conserve Habitat

In the figure below, A and B have the same development density, but in image B the lots are clustered and roads are designed to avoid habitat fragmentation.

A. Less habitat conserved **B. More habitat conserved**

A. Habitat fragmentation created by large lot zoning and no clustering. This also increases impervious surfaces and stormwater run off due to longer driveways.
B. Clustered development outside sensitive areas and near the main road con serves wider connected habitat.

Source: 1000 Friends of Florida, created by Benjamin Pennington

flood or destroy federal endangered species habitats.

- Many local governments require a sketch or concept plan for all major development. Sketch or concept plans can be reviewed at the planning staff level.
  - In the sketch or concept plan the developer should:
    - Consult and show the Conservation Data for Green Growth and aerial photos on development sketch plans and plats.
    - For large -scale developments, such as major subdivisions, Planned Use and Mixed Use development, obtain on-site survey information about the location of priority habitats during the stream or wetlands survey or from a qualified biologist. See Appendix B for a list of natural resource agencies that may be able to conduct surveys free of charge.
    - Describe the methods they plan to use from Section 3 of the GGT handbook to minimize impacts and connect contiguous unfragmented habitats on or adjacent to the site.
- Large-scale development proposals can be reviewed by a biologist or an outside entity with biological expertise. This is not a regulatory process, voluntary recommendations would be offered.

Dimensional Standards and Setbacks

- To reduce the amount of infrastructure and land taken up by developed uses it is important to minimize development set-backs as much as possible. Reduced front setbacks have also been shown to provide a better sense of community, since neighbors can see each other and are more likely to interact.
- Reducing setback distances helps to ensure lots do not fall within priority habitats which should be in a common area.

- Employ 'building envelopes'. All developed areas should be clustered and not dispersed across the site. Wildlife habitat should be unfragmented by development.

Parking

- Minimize parking and encourage over-flow parking on permeable surfaces such as grass. There is a wealth of information and model ordinance language via an Internet search on how to employ maximum instead of minimum parking standards to ensure developers do not build too much parking.

Open Space Design Standards

- The following recommendations also apply to any open space or conservation design standards in a conservation / cluster development ordinance.
- Separate active and passive open space criteria.
- Primary areas (highest priority) for all open space, if present on site, would be priority wildlife habitats represented in the Conservation Data.
- Incorporate the habitat conservation recommendations in Section 3 as standards in these ordinances. A convenient way to do this is to use the NC Model Natural Resources Conservation Ordinance definition of Significant Natural Resource Areas to define habitats and the order in which habitat on site should be conserved.
- Include language that requires the connectivity of habitat on site and connectivity to habitat adjacent to the site. All habitats and habitat corridors should be as wide as possible on all sides. (This language is in the NC Model Natural Resources Conservation Ordinance).

Wildlife habitat conditions change over time. As such, if conservation of specific habitat areas is required on developed sites, the delineation of the habitat must be based on a site survey and not only on a map depicting wildlife habitat. If the specific location of required open space on a development is voluntary, a site survey does not need to be required.

Protect Natural Heritage Sites

Natural Heritage sites are Natural Heritage Natural Areas (NHNAs) and the locations of Natural Heritage Element Occurrences (NHEOs). These areas are identified and mapped by the NC Natural Heritage Program. They support rare wildlife, plants, and natural communities. GIS map layers of SNHAs and NHEOs are provided through the Conservation Data for Green Growth and are detailed in Section 2.

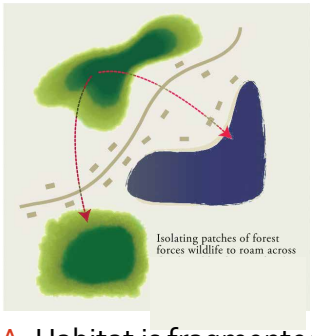
- Because they contain the rarest and most outstanding elements of biological diversity in our state, these areas are not appropriate for development.
- Permanently protecting these areas through land acquisition or conservation easements is the best way to conserve these areas.

If building must occur within Natural Heritage sites, these land development standards should be considered:

- The applicant should contact the NC Wildlife Resources Commission (NCWRC), so we can provide guidanc or consult with the US Fish& Wildlife Service (USFWS) to ensure they are not in violation of the US Endangered Species Act. The NCWRC can often let the applicant know if they need to consult with the USFWS.

Development Patterns that Connect Habitat

Encouraging clustered development and connected natural open space on adjacent lands allows wildlife and plants to disperse through the landscape. This reduces the chance that priority wildlife species will become threatened.



A. Habitat is fragmented

B. Habitat is connected

A. Habitat is separated by large lawns and dispersed buildings.
B. More clustered development allows habitat to be connected.

Source: 1000 Friends of Florida, created by Benjamin Pennington

- Completion of an environmental assessment to identify negative impacts that any proposed development project will have on the Natural Heritage site.
- Review of the environmental assessment by the NC Natural Heritage Program.

Example Ordinances

- The N.C. Model Natural Resources Conservation Ordinance (page 87).
- Carrboro, North Carolina, Land Use Ordinance Section 15-198 for open space standards ties design requirements to maps of habitat. The Development Application Checklist, includes an initial staff meeting, site visit, and the requirement to maintain contiguous habitat.[t]
- Hillsborough County and the City of Tampa, Florida, Upland Habitat Protection Ordinance is designed to protect important plant communities and wildlife habitat. Approved upland habitat plans are required before major development within significant upland habitats.[u]
- Section 7.6 General Design Standards of the Orange County, North Carolina, Unified Development Ordinance requires creation of one or more strategies to protect Natural Heritage sites.[v]
- Section 8.10 in Article 8, "Durham Inventory Site Protection Standards," of the Durham County, North Carolina, Unified Development Ordinance sets forth measures for protecting sites identified in Durham County's Natural Heritage Inventory.[w]

t https://townofcarrboro.org/298/Land-Use-Ordinance
u https://library.municode.com/fl/hillsborough_county/codes/land_development_code?nodeId=ARTIVNAREADPUFA_PT4.01.00NARE_S4.01.09ENSEARPLSIWIHA
v www.orangecountync.gov/1497/Documents
w https://durham.municipal.codes/UDO/8.10

Conservation and Cluster Subdivisions and Standards

Conservation subdivisions are popular because profit margins can be greater and the same number of homes, if not slightly more, can be accommodated while conserving natural open space. Many local governments have incentive-based ordinances for developers to cluster homes and set-aside open space. However, habitat fragmentation and destruction can happen when the open space standards above are not been incorporated into ordinances.

When development cannot be avoided in sensitive areas, nature-based development standards include:

- Minimizing habitat fragmentation
- Minimizing frontage and setback requirements to increase contiguous open space.
- Clustering development
- Utilizing building envelopes to minimize disturbance of natural vegetation on lots.
- Follow the guidance in Open Space Standards above.
- For details on how to design wildlife friendly developments, see Section 6.
- It is often possible to accommodate a mix of housing densities, from large lots to more affordable and attractive condo-type development, on site due to open space amenities and attractive housing appearance.
- In general, it is best to conserve 50 percent or more of the site.
- See Section 6 for more information.

Example Ordinances

These North Carolina ordinances contain some, but not all, components of an ecologically sound conservation development ordinance.

- We recommend using the NC Model Natural Resources Conservation Ordinance (page 87) in combination with a review of the following to understand how priority wildlife habitats can best be conserved in conservation / cluster subdivisions.
- Articles 614 and 815 of the Randolph County, North Carolina, Unified Development Ordinance outlines a Cluster Subdivision Overlay District. Incentives, such as density bonuses and planning assistance to developers, have led 50 percent of developers to choose cluster developments. They also address conservation of Natural Heritage Areas. The Birkhead Wilderness Small Area Plan in the UDO requires "Natural Heritage Subdivision Overlay Districts" be used for any residential development at a density of one unit per six acres. Forest Management Plans (usually provided by the NC Forest Service) are required and the three types of open space ownership and protection are included in the ordinance language. We recommend no significant area of natural open space be placed between roads and developed areas and that ordinances have a purpose of minimizing habitat fragmentation.
- The Chatham County, NC Conservation Subdivision Guidelines s provides a density bonus for conserving natural heritage areas and N.C. Wildlife Action Plan priority habitats on a minimum of 32 percent of the site.[x]
- Article 7, "Cluster (Conservation) Subdivisions" of the Franklin County, North Carolina, Unified Development Ordinance establishes open space standards that include some GGT recommendations for preserving wildlife habitat and significant natural areas.[y]

x www.chathamcountync.gov/government/departments-programs-i-z/planning/ordinances-regulations

y www.franklincountync.gov/county_services/planning_and_inspections_department/index.php

- Pima County AZ conservation subdivision ordinance (18.09.100) requires 50 percent conservation of the site not including infrastucture areas, defines Arizona priority habitats well, and discourages habitat fragmentation.[z]
- The NC State University Forestry and Environmental Outreach Program produced a guide to conservation subdivisions. It has numerous NC case studies.[aa]
- The Model Rural Cluster Development Ordinance from the SW Wisconsin Regional Planning Commission.[ab]


L.B. ROLLER

red-headed woodpecker

More examples of habitat conservation through development standards

- Fort Collins, Colorado, has included conservation measures for priority wildlife habitats in its development standards (Section 3.4.1)[ac] that are tied to a Natural Features and Habitat Inventory map.[ad]
- Boulder County, Colorado, Land Use Code, Section 7-1700, requires development proposals include a Wildlife Impact Report whenever the project is located within important wildlife habitats or wildlife corridors shown on conservation maps in the comprehensive plan. The report is developed by a biologist and is reviewed, approved, and monitored by the parks department.[ae]
- The Town of Davidson, NC Planning Ordinance requires environmental inventories and 40 percent or more open space conservation in districts outside of urban and suburban areas. Emphasis is placed on conserving wetlands and slopes > 20% in 'primary areas.' Included in 'secondary conservation areas,' are 600 foot wide riparian habitat zones along streams. (This is a recommendation from Section 3). [af]

Large Lot Subdivisions: Not ideal but sometimes in demand

Wildlife habitat will be better conserved in developments that have minimal lot sizes combined with larger blocks of unfragmented open space outside of development lots. However, where large lots (> 0.25 acres) are desired, ordinances could:

- Include building envelopes, maximum lot coverage proportions and minimal set-back distances to encourage habitat conservation on large lots.
- Require built structures should be near each other and near to roads, situated far from sensitive areas.
- Encourage most of the lot to be maintained in natural habitat except for a house, modest yard that accommodates the septic drain field (if applicable) and driveway.
- Encourage the connection of large areas of contiguous habitat between adjacent subdivisions.

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z http://pimacounty-az.elaws.us/code/coor_title18_ch18.09_sec18.09.100
aa www.ncufc.org/uploads/Conservation_subdivision.pdf
ab www.sewrpc.org/SEWRPCFiles/CommunityAssistance/ModelOrdinances/cluster_ordinance.pdf
ac www.fcgov.com/cityclerk/codes.php
ad www.fcgov.com/gis/downloadable-data
ae https://bouldercounty.gov/property-and-land/land-use/planning/land-use-code/
af www.townofdavidson.org/1006/Planning-Ordinance

Roads

- Encourage bridges, designed as wildlife crossings, on roads that run through high priority habitat. These can be installed during repair times and can reduce storm-debris damage when installed over streams.
- Pasco Co, FL include design standards for wildlife-road underpasses in their land development code (Chapter 800)[ag] and provide design guidelines in their Ecological Corridor Guidance document.[ah]
- Minimize the use and width of impervious surface and curb and gutter.
- See page 72 in Section 4 for wildlife crossing planning and design information.
- Use the NC Wildlife Commission cumulative impacts guidance document[ai] for design recommendations for other road or driveway-stream crossing structures.

Stormwater

Stormwater can present a challenge to high density development. Low Impact Development techniques can be used for density calculations and affordable stormwater treatment. Large lots are sometimes in demand and are needed for individual septic systems. Please see pages 58 to 60 in Section 3 for LID stormwater recommendations that can be written into ordinances.

- N.C. Department of Environmental Quality Stormwater-EZ is a voluntary LID approach encouraged by the our state.[aj]
- The N.C. State University *Low Impact Development Guidebook*[ak] includes a model ordinance.
- Consider allowing and encouraging "blue roofs" to slow stormwater run-off.

Community and Wastewater Treatment that Encourages Clustering

Where capacity exists and development is desired in rural areas, it is possible to encourage clustered development where sewer is not available by using community septic and other decentralized wastewater treatment systems. These systems are defined by the collection, treatment, and reuse of wastewater close to the point of origin and are thus, better for the environment when care is taken to monitor and manage the system. Community septic systems should consist of septic tanks on individual lots to maintain homeowner accountability but should have the drain field on common open space. Open space can be maintained as a native grassland or native plant meadow and can be placed at the entrance to the community. See the following for Low Impact Development guidance:

- N.C. State University *Low Impact Development Guidebook* chapter and curriculum module, "Wastewater Systems,"
- U.S. EPA guidance[al]

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ag https://library.municode.com/fl/pasco_county/codes/land_development_code
ah https://content.civicplus.com/api/assets/790fe2ff-95a4-45f5-89b5-51a6a7fa8528
ai www.ncwildlife.org/portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf
aj https://deq.nc.gov/about/divisions/energy-mineral-land-resources/energy-mineral-land-permit-guidance/stormwater-lid-storm-ez
ak www.planning.org/knowledgebase/resource/9141187/
al .www.epa.gov/septic

What are invasive, exotic plants?

Invasive, exotic plants are species that do not naturally occur in North Carolina but have been introduced by people. Many introduced plants pose no threat, but some grow out of control. Common invasive plants in North Carolina include:

- Kudzu (Pueraria montana)
- Japanese Stilt Grass (Microstegium vimineum)
- English Ivy (Hedera helix)
- Chinese Privet (Ligustrum sinense)
- Multiflora Rose (Rosa multiflora)

Kudzu has taken over this field.

Invasive species can cause significant damage to ecosystems, habitats, native species, and agriculture productivity. There are large economic costs from invasive species, so controlling them early on is important.

Tree Protection and Forest Conservation Ordinances

Ordinances that protect trees and forests will improve community resilience, as well as, community appearance and other benefits. To improve ecosystem health, it is important to encourage removal of nonnative and invasive tree and plant species, retain the native tree canopy and plant native, non-invasive vegetation. Tree protection will reduce energy use and costs through shading of homes and businesses, among other benefits, such as flood and drought reduction, ground water recharge, and greenhouse gas and heat island reduction. Retention of 50 percent of the tree canopy within a jurisdiction will greatly aid air quality and the drinking water supply, according to American Forests. This is also recommended for wildlife conservation. Consider the amount of development that zoning districts encourage over the study area to help determine the percent of canopy retention for certain types of development uses. Setting standards to conserve unfragmented, undeveloped forested areas on development tracts can simplify tree protection standards.

To effectively preserve the tree canopy within developed areas:

- Define requirements for minimizing the amount of *native* tree and shrub cover removed in connection with development.
- Require submission of a vegetation delineation as part of a development proposal that demonstrates the location of mature native trees and shrubs.
- Ensure that the native tree and shrub species of the region will be retained by species and diameter requirements. For example, mature longleaf pine trees native to the Sandhills have a smaller diameter compared to mature hardwood trees. Small to mid-size hardwoods should be removed in upland longleaf pine areas.

N.C. State University Forestry Extension Urban and Community Forestry Publications provide best practices for successful tree protection ordinances.

The North Carolina Division of Forest Resources Urban and Community Forestry Program offers grants and technical assistance to communities interested in tree protection.[am]

am http://ncforestservice.gov/Urban/Urban_Forestry.htm

Example Ordinances

- The Town of Chapel Hill, N.C., Tree Protection Ordinance (Appendix A, Article 5.7) requires applicants to submit a Landscape Protection Plan that encourages preservation of specimen and rare trees and significant tree stands. As part of its carbon reduction strategy, the town is working to address no net loss of the canopy cover and an increase in trees proportional to population growth.[an]
- Carroll County, Maryland's Forest Conservation Ordinance requires Forest Stand Delineations and Forest Protection Plans in development. The ordinance requires one acre of forest be planted for every acre removed. Reforestation is directed to priority areas (i.e., stream buffers, wildlife corridors, steep slopes, etc.).[ao]

Landscaping and Vegetation Control Ordinances

Control invasives and maintain natives!

In addition to tree protection, local ordinances can include measures to promote and maintain native species of vegetation and discourage the introduction and proliferation of invasive, exotic species. These types of ordinances can vastly reduce water shortages because a significant amount of water is used to maintain nonnative landscaping. Native species are tolerant of local climate and do not need to be watered as often. Maintaining and planting native plants is critical to maintaining bird populations. In spring, young chicks are fed a 100 percent insect diet of hundreds of insects per day. Insect resistant and nonnative plants vastly reduce the abundance of beneficial insects, such as butterflies and native bees. Components of an effective landscaping or vegetation control ordinances will include:

- Landscaping plant lists that feature native plants at the top of the list, as few nonnative plants as possible and no invasive plants.
- Language that prohibits the introduction of invasive, exotic plants and insect resistant plants during the development process.
- Language that limits planting of insect resistant plants to below ten percent.
- Requirements for the removal of invasive plants.
- Landscaping standards for public works projects so that native (and drought resistant) species are required in local landscaping projects.

For information and lists of invasive, nonnative plants in North Carolina, see Section 3, page 60.

Example Ordinances

- Moore County NC UDO Chapter 7, Sec. 7.11 H. - J. outlines recommended native plants and prohibited non-native invasive plants.
- Brevard County, Florida's Land Clearing Performance Standards, Sec. 62-4335, is a particularly exemplary model that requires removal of nonnative, invasive plants and requires vegetation control to curb proliferation.[ap]

an www.townofchapelhill.org/government/departments-services/parks-and-recreation/parks/park-maintenance/trees-in-chapel-hill/tree-protection

ao www.carrollcountymd.gov/government/directory/land-resource-management/resource-management/programs/forest-conservation-program/

ap https://library.municode.com/fl/brevard_county/codes/code_of_ordinances

GREENING HAZARD MITIGATION AND RELATED ORDINANCES

Conserving upland habitats using any of the recommendations in the GGT will reduce the impact of hazards such as flooding, drought, and wildfires. However, many priority wildlife habitats are hazard prone areas such as floodplains and fire-prone forests. Conserving wildlife and habitat in hazard prone areas is essential to reduce the severity of hazards to residents. It is important to understand potential future hazards from climate change that could affect your community.

Stream, Wetland and Floodplain Ordinances

To adequately protect public safety and welfare, these ordinances can protect important species, habitats, and ecosystems if allowed in the NC general statutes. If local governments are not prohibited from enacting local ordinances that are more protective than state and federal law, we recommend the following:

- Require that applicants demonstrate approved state and federal wetlands permits prior to construction.
- State the economic and environmental importance of maintaining biologically functional streams, wetlands, and floodplains.
- Define specific buffer widths, based on science, within which no permanent structures are allowed.
- Discourage or disallow major development in the 100 or 500-year floodplain.
- Encourage the management of stormwater on site through Low Impact Development techniques such as rain gardens, native vegetation, constructed wetlands, and swales

Section 3, "Habitat Conservation Recommendations," outlines more specific stream, wetland and floodplain protection standards that can be codified into ordinances.

Example Ordinances

- Section 304 of Chatham County, North Carolina, Watershed Protection Ordinance establishes strong buffer requirements for perennial, intermittent, and ephemeral streams, springs, seeps, and wetlands. It requires that field delineations of streams accompany development proposals. In addition, Chatham County's Flood Damage Prevention Ordinance prohibits development in the 100- year floodplain.[aq]
- The Town of Wolfeboro, New Hampshire, Wetland Conservation Overlay District, Zoning Ch.175 Article II, functions to buffer and connect wetlands and streams by establishing a 100 foot, no touch buffer around prime wetland complexes.[ar]
- Orange County, NC does not allow new structures in the floodplain. See the bottom of www.orangecountync.gov/1309/Floodplain-Information.

aq www.chathamcountync.gov/government/departments-programs-i-z/planning/ordinances-regulations
ar http://ecode360.com/10186926#10186926

Steep Slope Protection Ordinances

Steep slopes are often biologically diverse and support unique plant communities, rock outcrops, cliffs, and other important habitat features. When development occurs on or adjacent to steep slopes, sedimentation and erosion can damage important downhill resources and scenic views. Not to mention landslides put people and property at risk. Steep slope protection ordinances can assist in preserving important natural assets by limiting development on certain slopes, landslide prone areas and:

- Areas with important wildlife habitats on, near, or downhill.
- Areas above a certain elevation.
- Areas with particularly important views.

Example Ordinances

- The Land of Sky Regional Council has developed a report to be used in the development of steep slope protection ordinances.[as]
- Park City, Utah's Sensitive Area Overlay Zone, Ch.15 - 2.21-3, regulations require protection of steep slopes and ridgelines as part of a broader set of overlay zones that also encourage preservation of wildlife habitat and wetlands.[at]
- The Lyme, New Hampshire, Steep Slopes Conservation District, Article 3.27.2, limits development activities where the average slope is 20 percent or greater. It limits development in areas that are visible from public waters and roads. [au]
- Pickens County, Georgia, Mountain Protection Plan ordinance, Section 26.91 to 26.120, limits development in areas that are 2,200 feet in elevation and on slopes of 25% or more.[av]

Wildfire Hazard and Smoke Management

Wildfire hazard ordinances can help your community minimize wildfire and manage smoke conflicts while keeping forests healthy.

Many habitats and wildlife in North Carolina are fire-dependent. Occasional fires clear out thick, dense vegetation, improving habitat for many species. Prescribed burning is used as a resource management tool on many public lands.

Prescribed fire at the edge of a Managed Area threatened by housing encroachment.

Prescribed fire is also an effective strategy to reduce woody fuels and wildfire risk to communities. This is especially important in preparation for periods of drought.

as http://www.landofsky.org/pdf/LGS/LandofSky-MRSSPS-final-report.pdf
at https://www.parkcity.org/departments/planning
au https://www.lymenh.gov/planning-and-zoning-administrator/pages/regulations-ordinances
av https://library.municode.com/ga/pickens_county/codes/code_of_ordinances?nodeId=PTIICOOR_CH26EN_ARTIVMOPRPL

Why is this important to planning?

The smoke associated with prescribed burning can pose a risk to smoke sensitive individuals, such as people with asthma, and can cause hazards, such as reduced visibility on roadways.

- The greatest risk occurs within a half-mile radius of a burn, which is referred to as a Smoke Awareness Area.
- When housing, schools, prisons, businesses, or extensive roads occur within a smoke awareness area, it is difficult for land managers to obtain a permit to conduct prescribed burns and the chance for catastrophic fires increases.

Many communities in North Carolina are located in the wildland-urban interface where development is encroaching on habitats where wildfire risks can be high, if habitats are not managed with prescribed fire.

How can an ordinance help?

Local ordinances can help to manage risks associated with built infrastructure next to areas where prescribed burning occurs. Effective ordinances can:

- Limit incompatible land uses (schools, roads, nursing homes, hospitals, high density development) within a half- mile buffer of lands where prescribed burning occurs regularly.
- Land use within Smoke Awareness Areas would ideally be limited to very low density residential uses and agricultural uses.
- Cluster structures instead of spreading them throughout the recommended half-mile Smoke Awareness Area. Land managers may be able to avoid "putting smoke" on houses this way.
- In addition, we recommend all new developments within this buffer provide disclosure forms to new residents explaining that they will occasionally be exposed to smoke from prescribed burns.
- If the development will take place near natural open space, ensure that the applicant complies with Firewise Communities guidelines to protect homes from wildfire. www.firewise.org

Where does prescribed burning occur in my community?

- The Smoke Awareness Area map is provided as part of the Conservation Data for Green Growth (see Section 2, page 33).
- For more information about prescribed fire in North Carolina, see page 4 and the North Carolina Prescribed Fire Council website http://ncprescribedfirecouncil.org/.

Example Ordinance

- The Jefferson County, Colorado Wildfire Hazard Overlay District limits land uses and requires hazard mitigation strategies around any dwellings and/or the submission of a wildfire mitigation site plan for developments located within the district.

ENERGY SYSTEMS ORDINANCES: MINIMIZING WILDLIFE IMPACTS

Wind Energy Systems Ordinances

As communities seek to promote renewable energy to reach North Carolina's renewable energy standard, wind energy is often considered. Certain wind energy systems, however, can have significant negative and avoidable impacts on wildlife.

The North Carolina Wind Energy Working Group defined the issues related to wind development for communities. Some of the issues considered include public safety concerns like setbacks from buildings and property lines, noise and wildlife impacts, among other issues. For more information on common types of wind power projects visit the American Wind Energy Association website http://awea.org.

There are unique sets of concerns and regulatory issues for projects of different scales. NCDEQ now has a permitting process for onshore wind facilities.

Wildlife Impacts from Wind Farms Considered in Permitting

Direct mortality - is the greatest impact to wildlife. The time of year and turbine speed directly affect mortality. On average, two birds are killed per turbine per year.[21] Estimates for bat mortality have reported that as many as 33,000 to 111,000 bats are killed per year by wind facilities in Pennsylvania, West Virginia, western Maryland, and Virginia.[22]

Habitat loss or alteration - occurs when natural habitats are cleared for the installation of wind turbines, infrastructure, and transmission lines. For example, ridgetop projects in the Appalachians have been converting forests to roadways and open fields.

Habitat and area avoidance by wildlife - Many declining species of wildlife will abandon areas or fields that contain wind turbines due to constant disturbance by the flickering shadows, lights, and movements of turbines. This has been observed particularly in certain waterfowl [23, 24, 25] and raptors and many grassland birds[26, 27].

Connectivity issues - Connecting wind farms to energy transmission lines requires building new, above ground infrastructure that can limit the mobility of wildlife in the area. Birds and bats can collide with above ground transmission lines.[34]

Resources for Wind Energy Systems Ordinances

- The North Carolina Wind Working Group has prepared a model wind ordinance for local communities. Examples of how counties like Watauga, Ashe, Carteret, Camden and others have used and adapted this model and additional models from across the nation can be found at https://energy.appstate.edu/additional-tags-categories/north-carolina.[aw] Search the database for "wind" and "policy or regulation."
- The Department of Energy and others also have produced a guide for county commissioners.[ax]
- For commercial wind projects and their environmental review, two good summary documents include the, "U.S. Fish and Wildlife Services Guidance on Siting Land-based Wind Energy Projects."[ay]

A special thanks to Curtis Smalling of Audubon North Carolina for providing this information.

aw https://energy.appstate.edu/additional-tags-categories/north-carolina
ax www.osti.gov/biblio/896718
ay www.fws.gov/media/land-based-wind-energy-guidelines

Solar Energy Systems Ordinances

NC is on of the top solar energy producers in the country in solar farms. It has become a popular form of economic development, energy independence and low pollution source of power. However, large swaths of land are developing into solar farms, so incorporating wildlife habitat conservation measures is very important.

MICHA JOST *Rooftop Solar*

- Encourage co-location of solar installations on top of existing built structures. Doing so, where possible, uses less land.
- Include requirements for optimum solar building orientation and require that solar 'stub-ins' be constructed during building renovation or construction. 'Stub-ins' support rooftop solar panels and are affordable.
- Land-based solar installations should be built away from sensitive wildlife habitats and forests ideally should not be cut in order to build a solar farm.
- Encourage compact solar panel design to allow for more energy generation in less space.

Resources for Solar Energy Systems Ordinances

- Use the detailed NC Wildlife Commission mmendations on our website.[az]
- The N.C. Sustainable Energy Association and the N.C. Solar Center provide a template solar energy systems ordinance for North Carolina communities.[ba]

More Information on Greening Incentives and Ordinances

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KENDRICK WEEKS

hooded warbler

SECTION 6. GREENING DEVELOPMENT SITE LOCATION, REVIEW, & DESIGN

ACHIEVE GREEN GROWTH IN DEVELOPMENTS

Greening development review and site design means selecting appropriate development sites and using conservation data and North Caroline Wildlife Commission habitat conservation recommendations to review and design developments. Sites that are next to Managed Areas or other high priority conservation areas will degrade wildlife habitat and natural resources regardless of how they are built. Wildlife that need especially large areas, are impacted by roads, or depend on fire disturbance will not be conserved on a single development tract. Developments that are appropriately located and maintain large areas of connected habitat among adjacent tracts can be designed to reduce impacts to wildlife.

- Planning staff and advisory boards can "green" the development review process by:
  - Requiring a sketch plan and a pre-design meeting with stakeholders[1]
  - Using the Conservation Data for Green Growth and habitat conservation recommendations in Section 3 to evaluate development proposals
  - Advising applicants on how to design wildlife friendly development projects

- Developers, consultants and engineers can "green" site design by:
  - Using the Conservation Data for Green Growth and habitat conservation recommendations in Section 3 prior to site selection and design.
  - Selecting sites that are not next to Managed Areas or priority conservation areas.
  - Mapping and protecting unfragmented habitats and buffers.
  - Applying for Wildlife Friendly Development Certification ahead of site design. www.ncwildcertify.org.

Why "green" site design?

"Greening" site design can:
- Increase property values for desired lots.
- Produce more profitable developments.
- Connect children and residents with the outdoors.
- Preserve ecological resources for future generations.
- Help to prevent hazards such as flooding and drought.

STEPS TO MAINTAIN A CONNECTED NETWORK OF HABITATS ACROSS DEVELOPMENTS

Wildlife do not live solely within the wet areas of wetlands, streams or rivers. Wildlife need to range on land adjacent to water bodies. A wildlife friendly development conserves terrestrial habitats located in the uplands next to wetlands, floodplains and riparian areas.

Following these steps may also help ensure that developers comply with the Endangered Species Act and other environmental requirements ahead of permitting.

Step 1. Select an appropriate site for the type of development. Appropriate, green sites for major development are:

a) Centered around towns and cities so that urban or suburban areas will not spread extensively into rural areas. Rural cluster developments are an exception to this.
b) Not adjacent to Managed Areas (conserved lands) or within priority conservation areas.

Step 2. Create a map of important upland and wetland habitats on and adjacent to the site.

a) Depict the Conservation Data for Green Growth (statewide and regional appendix data) on development maps. Include areas adjacent to the parcel.
b) Map the boundaries of upland terrestrial and wetland habitats that will be conserved on site. The boundaries of these habitats can be partially mapped through analyzing aerial photos, but field surveys will be needed to fully delineate boundaries.
c) As needed, have a qualified biologist survey for mapped and unmapped priority habitats on site. If staff or funds are not available for this, see Appendix B for a list of conservation partners who may be able to conduct surveys at no cost. Surveys can typically be done in a few hours to one day.

Step 3. Use the habitat map created in Step 2 to design an upland and wetland habitat network that will be protected and connected to other natural areas on and off site.

a) This green infrastructure network should consist of large core areas of unfragmented, continuous habitats that are connected by wildlife travel corridors.[2]
b) Design wildlife habitat core areas to be as large as possible and to maximize interior area while minimizing habitat edge.

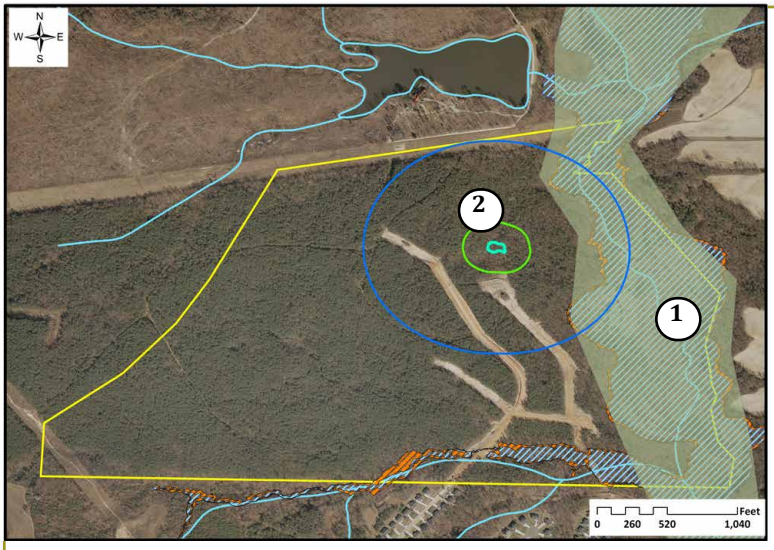
Protecting Habitat for Bald Eagles

U.S. FISH & WILDLIFE SERVICE

Although bald eagles are no longer listed as endangered they are still protected under the Bald and Golden Eagle Protection Act.

The U.S. Fish and Wildlife Service has created a set of National Bald Eagle Management Guidelines (www.fws.gov/southeast/es/baldeagle/) for protecting bald eagle nesting sites alongside other land uses.
The N.C. Wildlife Commission can provide maps of bald eagle nests to local governments and landowners. Contact us for a copy of this data at greengrowth@ncwildlife.org.

Visual Example for Step 2



This is a development scenario near Knightdale, North Carolina, and the route of a future major highway. The scenario exemplifies the need to review a development using conservation data before any final plans are made. This example is hypothetical and in reality a field survey was not conducted on-site. The site is outlined in yellow. The tract is about 160 acres and the zoning is 1 – 4 units per acre. 1) The floodplain underlies most of the Natural Heritage Area. 2) A small wetland found during a site survey is in turquoise. There are two buffers mapped on the small wetland a critical habitat 150 foot buffer and a further 600 foot secondary upland habitat zone. See Section 3 pages 54 to 57 for more information on these buffers. Ideally, this second buffer zone would lie completely out of the floodplain to provide non-flooded areas for amphibians and reptiles to burrow underground.

c) Design wildlife corridors to be as wide as possible, minimize trail widths, maintain forest canopy cover and the forest understory of shrubs and ground cover.[3]

d) Design wildlife core habitat and travel corridors following the habitat conservation recommendations in Section 3 to conserve:

- Habitat for federally protected species, such as bald eagles,
- Natural Heritage Areas,
- Priority wildlife habitats identified in the N.C. Wildlife Action Plan,
- Wetland, stream, or river buffers,
- Natural open spaces that connect or buffer existing protected natural areas.

Step 4. Permanently protect as much of this upland habitat network as possible by:

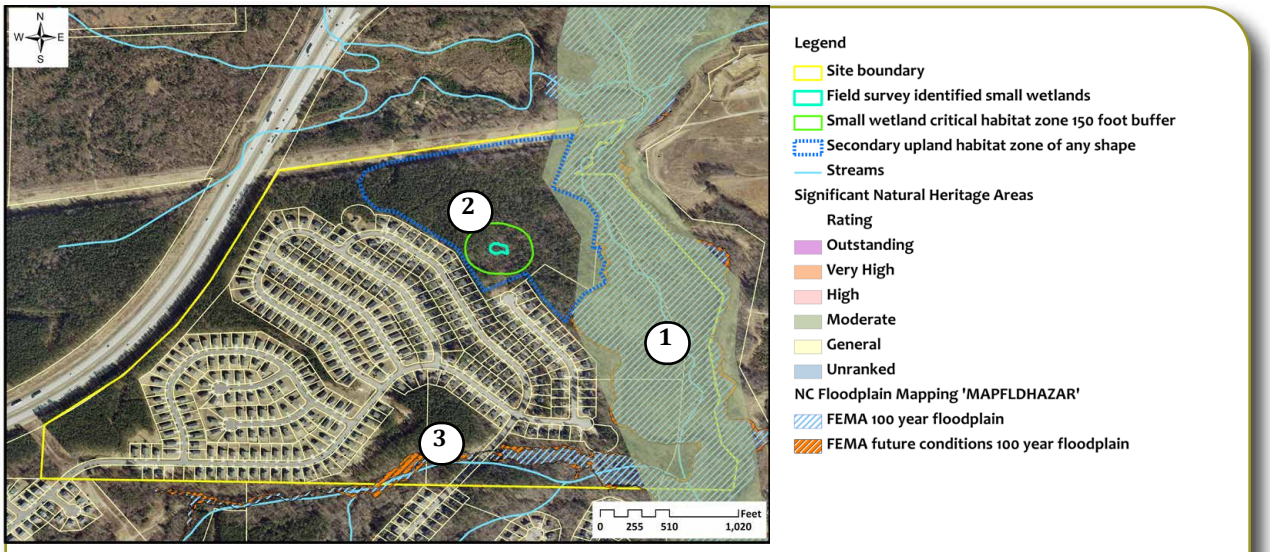
a) Clustering homes on smaller lots as much as possible.

b) Using a conservation easement or equivalent legal tool. See Appendix B for potential land conservation partner contacts.

Step 5. Create an upland habitat management plan for the habitat network.

a) Without active management, habitat structure and plant species composition may deteriorate and the habitat may become unusable to priority species. This is because habitat management mimics natural disturbances, such as fire, that no longer occurs in developed areas.

Visual Example for Steps 3 and 4



Development is centralized and habitat edge is minimized. 1) The floodplain and Natural Heritage Area are conserved by being outside of lots. 2) The small wetland critical habitat zone is not disturbed and the secondary zone is connected to the floodplain. This secondary zone can be of any shape but should be outside flooded areas and should be of equal size to a further 600 foot buffer on the critical zone, which was not completely achieved here. 3) The streams to the south are buffered by at least 100 feet and lots are outside of the stream buffer and floodplain. The homeowner association owns the natural contiguous open space.

b) Plans can be developed to actively manage protected natural areas using techniques, such as: periodic mowing outside of the nesting season, thinning of trees, reforestation, protection of dead trees and canopy gap creations (small clearings in the forest).

c) Create a long-term funding mechanism to implement goals and objectives of the natural resource management plan, such as collecting fees from the home owner association. The HOA can profit from tree cutting and mowing by selling timber or native grass hay.

d) Partner with a land trust, parks department or natural resource agency to create and implement the management plan. Habitat management may qualify the land for tax credit and financial incentive programs.

e) Seek outside assistance from natural resource professionals in crafting and reviewing such plans. See Appendix B for an abbreviated directory of professionals who may be able to provide such assistance.

Step 6. Landscape using native plants.

Native plants are more adapted to the local climate and do not need as much water or maintenance. See Section 3, page 60, for more information.

A note about emergency response and street design

Public health and safety is one of the paramount concerns for making certain streets are interconnected among neighborhoods. Grid street designs are more space efficient and lead to more walking and sense of community. To avoid impacts to streams, avoid or minimize road crossings over streams.

EXAMPLE DEVELOPMENTS

Listed below are a few examples of development projects that have incorporated many wildlife friendly development practices.

The Woodlands, Davidson, North Carolina

- An award-winning, 56-home neighborhood that is a Certified Wildlife Friendly Development.
- The developer conserved a wide riparian buffer and 23 acres of contiguous riparian forest in an urbanizing area.

Harmony, Florida

- Voted one of the top 50 places to retire in the U.S.
- Over half of the development has been set aside as a nature preserve, which is actively managed for preservation and enhancement of wildlife habitat.
- Harmony has a well-qualified Conservation Director on staff who guides conservation and management activities in this planned community.
- The development uses "Dark Sky" streetlights to minimize the negative effects of artificial night lighting on wildlife.
- The developer also partnered with the University of Florida's Wildlife Extension department to develop an environmental education website and outreach programs for residents.

Creston, North Carolina

- The Creston Development[a] has placed 40 percent of the project area under a conservation easement with Foothills Land Conservancy, the local land trust.
- The conservation property is actively stewarded by land trust staff.

Bundoran Farm, Virginia

- Bundoran Farm[b] planned community has a large contiguous wildlife habitat conservation area that is connected to adjacent protected habitat, off-site.
- Large, conserved grasslands are also used for ranching.
- Building envelopes were designed for habitat conservation and connectivity.

a http://www.creston-nc.com/
b www.bundoranfarm.com

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3 Mason, J., C.E. Moorman, G. Hess and K. Sinclair 2006. Designing suburban greenways to provide habitat for forest-breeding birds. Landscape and Urban Planning, 1-13 and Sinclair, K.E., G.R. Hess, C.E. Moorman and J.H. Mason. 2005. Mammalian nest predators respond to greenway width, landscape context, and habitat structure. Landscape and Urban Planning, 71, 277-293.

APPENDIX A
LISTED SPECIES AND PRIORITY HABITATS

As we have explained throughout the toolbox, it is important to know about the species and habitats that are priorities for conservation in your community.

Federally Listed Species

- The U.S. Fish and Wildlife Service maintains a list of plant and animal species that are federally endangered, threatened and of special concern.
- Species listed as federally endangered or threatened are protected under the Federal Endangered Species Act (16 U.S.C. 1531 to 1543), meaning that the plant/animal or habitat cannot be harmed unless a permit is obtained through consultation with the U.S. Fish and Wildlife Service.
- At-risk species are species that are proposed to be listed or are in process of becoming listed. Further research is typically needed to determine the conservation status of an at-risk species.
- Following the recommendations in this guide will help to avoid and minimize negative impact to endangered species, but will not necessarily fulfill all regulatory requirements under the Endangered Species Act.
- For specific regulatory questions about a federally listed species, please contact the U.S. Fish and Wildlife Service at (919) 856-4520 in eastern NC, (828) 258-3939 in western NC, or visit www.fws.gov/raleigh/es.html
- To find out what federally listed species exist in your county and to view fact sheets about the species, visit www.fws.gov/species/search.

State-Listed Species

- State-listed species are protected under the State Endangered Species Act (G.S. 113-331 to 113-337), which is administered by the North Carolina Wildlife Commission.
- For a complete list of state listed species (divided by region) in North Carolina, download the document, "Protected Wildlife Species of North Carolina," from www.ncwildlife.org/Portals/0/Conserving/documents/Protected-Wildlife-Species-of-NC.pdf.

Other Priority Habitats and Species

- In addition to federal and state listed species, other species and habitats are considered priorities for conservation. Priority habitats, and the species that depend on them, are identified and described in North Carolina's Wildlife Action Plan.
- For more information on priority species and habitats listed for your region, see the North Carolina Wildlife Action Plan: www.ncwildlife.org/plan

APPENDIX B

AGENCIES AND ORGANIZATIONS WITH TECHNICAL EXPERTISE

Many organizations and agencies can provide technical expertise to your town or county on Green Growth or related topics. Each organization's general contact information and primary expertise is outlined below.

State and Federal Agencies

The state and federal agencies listed below possess expertise related to planning for Green Growth. Note that agencies with regional expertise (particularly coastal agencies) are not listed below; these agencies are listed in regional appendices.

Agency	Primary Expertise	Contact
N.C. Wildlife Resources Commission	• Can assist local governments with Green Growth planning • Information about listed and priority species identified in the NC Wildlife Action Plan • The agency's Habitat Conservation Division can provide information and assistance related to environmental permitting.	• For general Green Growth Toolbox Project: (910) 638-4887 or (919) 630-3086 • For environmental permitting issues, Habitat Conservation staff at: (919) 707-0222
U.S. Fish & Wildlife Service	• Endangered Species Act • Information on planning related to federally listed species	• Raleigh Field Office: (919) 856-4520 • Asheville Field Office: (828) 258-3939
N.C. Natural Heritage Program	• Inventories, catalogues, and supports conservation of the rarest and the most outstanding elements of the natural diversity of our state • Can conduct, update, or help interpret your county's Natural Heritage Inventory	• For data and data access questions: (919) 707-9392
N.C. Forest Service, Urban Forestry Program	• Provides technical guidance to communities on tree preservation and urban forestry issues • Provides funding, through the Urban and Community Forestry Grant Program, for developing local urban forestry programs	• Urban Forestry Program Coordinator: (919) 857-4842

N.C. Division of Water Resources (DEQ), Planning Section	• Coordinates nonpoint source reduction efforts	• Contact Planning Section staff at: (919) 707-3630
N.C. Division of Parks and Recreation (DNCR)—State Trails Program	• Guidance to help local governments plan, develop, and manage trails and greenways • Provides grant funding to help organizations, including county and municipal governments, fund trail development and management	• Contact State Trails Program at: (919) 707-9300
N.C. Division Energy, Mineral, and Land Resources: Erosion and Sediment Control & Stormwater Programs (DEQ)	• Technical assistance on local erosion, sedimentation control issues and stormwater management	• For contact information for the Stormwater Program, see: https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/stormwater/stormwater-program • For contact information for the Erosion and Sediment Control, see: https://deq.nc.gov/about/divisions/energy-mineral-and-land-resources/erosion-and-sediment-control
N.C. Division of Soil and Water Conservation (N.C. Department of Agriculture & Consumer Services)	• Provides technical assistance to soil and water conservation districts and local governments to protect soil resources and improve water quality • Guidance on a variety of water shed management issues	• For contact information, see: www.ncagr.gov/SWC/findyourdistrict.html
N.C. Division of Mitigation Services (DEQ)	• Develops local watershed plans that address sources of water quality degradation • Coordinates watershed improvement and restoration projects • Guidance on strategies and solutions to address watershed degradation	• Contact or ask for your county's project manager: • Raleigh Office: (919) 707-8976 • Asheville Office: (828) 296-4500
N.C. Cooperative Extension—Ecology or Wildlife Programs	• Multiple programs that provide technical guidance related to local environmental planning	• https://forestry.ces.ncsu.edu/forestry-wildlife/
N.C. Department of Commerce—Office of Community Planning	• Provides technical assistance to local governments on land use planning issues.	• www.commerce.nc.gov/data-tools-reports/planning-services-tools

Land Trusts

Land trusts are primarily involved in protecting land through acquisition or conservation easements. Land trusts can be good partners in helping your community craft strategies to protect important lands for future generations.

Organization	Primary Expertise	Contact
NC Land Trusts	• Guidance related to conservation planning, land protection and land management/stewardship	• To find your local land trust, see: https://landtrustalliance.org/land-trusts
Trust for Public Land	• Guidance or partnerships to protect land in certain areas of North Carolina • Guidance related to conservation finance (i.e., developing local means to pay for land conservation)	• Contact the North Carolina Chapter Office at: (919) 836-0571
The Nature Conservancy	• Conservation planning, land protection and stewardship expertise	• Contact the North Carolina office: (919) 403-8558 or northcarolina@tnc.org
The Conservation Fund	• The Community and Economic Development Program provides assistance to communities on integrating environmental protection and community development, including conservation plans for affordable housing.	• Contact the North Carolina office at: (919) 967-2223

Regional Organizations

Communities in different regions will have access to different sources of technical guidance. Lists of regional organizations you can contact for assistance are provided in the Regional Appendices. However, most communities across the state will have a Council of Government or a conservation partnership nearby that may be able to provide assistance.

Agency	Primary Expertise	Contact
Councils of Government	• Land use planning-related technical assistance • If available, see addendum specific to your region for more information.	• www.ncregions.org
Conservation Partnerships	• Regional conservation partnerships in North Carolina can provide technical guidance related to conservation planning. • If available, see appendix specific to your region for more information.	• See your GGT Regional Appendix if available. • See: www.ncnhp.org/conservation/conservation-planning-tool/resources/other-efforts

APPENDIX C
HUMAN-WILDLIFE CONFLICT PREVENTION

As development in North Carolina spreads, urban-adapted wildlife and people are increasingly coming into contact with one another. Certain species—Canada geese, deer, raccoons, rabbits, opossums, bears, coyotes and foxes - can adapt to developed environments and will take advantage of available food and shelter. Conflicts can arise when animals dwell around stormwater ponds, dig up gardens, prey on outdoor pets, den in, near, or under housing structures, consume or destroy landscaping vegetation or root through trash cans.

The presence of some wildlife, such as foxes, coyotes, raccoons, opossums and even bears, in suburban areas is a result of these species being able to access garbage cans, outdoor pets, pet food, and bird feeders, especially at night. If food sources are made unavailable, these species will leave the area. The public often call wildlife control professionals and wildlife agency staff to remove wildlife from residential areas, which is not possible or is unsuccessful in many cases. The key to preventing human-widlife conflicts is for: residents to remove trash and pet food sources around their homes, communities to have large natural habitat open space areas, and to allow for well-controlled hunting in suburban areas.

Overpopulation by urban-adapted wildlife not only can cause problems for people, but can also cause harm to wildlife. For example, when too many deer exist in an area they can overgraze their wild plant foods and many end up starving or surviving in very poor health.

The key to managing human-wildlife conflict is to educate the public on the points below and to look for the most effective way to reduce outdoor trash and pet food availability, increase natural open space, and amend local laws to allow trapping or hunting. Increasing natural open spaces in fields and forests will allow for food availability away from residential areas. Hunting and trapping will in turn reduce the high density of urban-adapted species.

Local governments and residents can take steps to proactively prevent human-wildlife conflicts.

- Provide animal and bear proof trash cans through your community's waste disposal program. Several companies can supply these. If you have black bears make sure the cans are proven to be truly bear proof.
- Educate, encourage or require the public not to actively feed wild animals by taking in their bird feeders in the evening and not placing food in their yards to feed pets, feral cats or wildlife.
- More recommendations can be found in our Best Management Practices for Development.

Please note: It is beneficial to plant annual native wildflowers and warm season grasses in backyards to benefit wild birds and other native wildlife that are not considered a nuisance. Annual plants that are not as abundant in the winter will help to reduce deer conflicts.

- Prevent overpopulation of deer
  - Explore the feasibility of an urban archery season. www.ncwildlife.org/Conserving/MunicipalitiesCounties.aspx
  - Consider enabling hunting with firearms in large open spaces associated with conservation subdivisions or parks on a few days when public access is restricted.
  - Encourage the use of deer fencing, especially around food gardens.
- Provide trapping opportunities during the trapping season to manage problematic animal populations—such as raccoons and foxes—in certain areas.
- Encourage homeowners to keep domestic cats and dogs indoors. Cats allowed outdoors negatively impact sensitive bird, reptile, and amphibian populations, while also attracting problematic wild animals that hunt cats and dogs.

For more information about preventing human-wildlife conflicts, visit the following website, www.ncwildlife.org/Trapping/HaveaProblem.aspx.

Bats in the attic and chimney swifts in the chimney.

In suburban areas large hollow trees are scarce and houses are usually the only remaining structures where certain bat species and chimney swifts can roost or raise their young.

It is important to the conservation of these species to provide alternative roosting structures for them if you need to close off your home or chimney to bats, chimney swifts, or other native wildlife that have taken up residence (owls, flying squirrels, etc.). There are a variety of nesting or roosting boxes that can be placed in the appropriate habitat nearby.

It is critical that you do not trap animals in the house when screening is put into place. Chimney swifts are protected under the Migratory Bird Treaty Act. Contact the U.S. Fish and Wildlife Service if you feel you need to do something. See Appendix B for contacts.

For chimney swifts:

- Consider tolerating the swifts which only use chimneys during the spring through early fall when fire places are not typically used. Make sure you clean out the chimney before you intend to use it in the fall after the nesting season is over.
- If possible consider constructing an alternative chimney like structure near your home for the swifts to use. See www.chimneyswifts.org for more information.
- Screening the top of the chimney should be done during winter to avoid trapping actively nesting birds inside the chimney.

For bats:

- Contact a professional who will do the following:
  - Screen house openings only outside of the breeding season during the winter.
  - Screen house openings during night hours while bats are outside.
- Consider constructing a bat house nearby where your 'house bats' can go. This is a very affordable and fun project. Bats are great to have in the yard to control insects and mosquitos. See the following website for bat house information www.batcon.org/index.php/get-involved/install-a-bat-house.html.

APPENDIX D
GLOSSARY

Aquatic Species: Species of organisms that require water during their entire life cycle.

Biological Diversity: Also known as biodiversity, this term refers to the entire diversity of life in an area—including variation within and among species, natural communities and ecosystems. The more types of species and habitats in an area, the higher its biodiversity.

Climate Resiliency: The capacity of a community or a natural ecosystem to prevent, withstand, respond to, and recover from a climate-related event.

Conservation Concern: Sufficient evidence exists that species and or habitats may become threatened or endangered with extinction.

Conservation Data: Maps and information about habitats, animal and plant species of conservation concern. This data is mostly collected on the ground and is compiled by experts.

Conservation Planning: Process that occurs when a group of stakeholders consider the status of an area's natural environment and identify goals and strategies for conserving the area's natural heritage and biological diversity.

Conservation Priority: See page 64.

Conservation Strategies: Steps that can be taken to conserve a community's most valuable environmental assets. See page 67.

Conservation Value (and rank): The importance level of conserving a natural area due to the presence of rare species and habitats, high biodiversity or the presence of high-quality habitats or populations of wildlife.

Core Habitat: High-quality habitat that is not fragmented and has a large interior far from a habitat edge of incompatible land. Conditions where wildlife and plant populations can obtain most of the resources needed for maintenance of their population levels. See page 48.

Data Layer: A map layer that is in a Geographical Information System and which contains data about the features represented in a mapped location.

Ecosystem and Ecosystem Services: See page 8.

Ephemeral Wetland: A type of small wetland community. Temporary wetland pool that typically fills with water during winter and dries by summer. Because they dry out during part of the year, these wetlands do not support fish which prey heavily on amphibian eggs. These pools provide important breeding habitat for semi-aquatic amphibians.

Field (or Site) Survey: Biological surveys conducted by experienced natural resource professionals during suitable times of the year to document flora, fauna and habitats.

Fire-dependent Species: Species of animals and plants that require habitat where occassional fire occurs. Fire clears out old vegetation, leading to a more open habitat structure.

This allows plant seeds to open and or touch bare mineral soil, which is needed for fire-dependent plant growth.

Food Web: Also called a "food chain." The feeding connections (who eats what) in a natural community of animals and plants. Food webs help to maintain natural levels of various species and nutrients in a habitat and ecosystem.

Game Land: Public land that is owned or managed by the North Carolina Wildlife Resources Commission. Game Lands are actively managed to provide wildlife habitat and wildlife-related recreation opportunities, including hunting, fishing, and wildlife watching.

Geographical Information Systems (GIS): A computer-based system for mapping and analyzing spatial data and information about mapped features (map layers).

Green Growth: A type of land use planning that conserves biological diversity, important fish and wildlife habitat, and associated natural resources as communities continue to grow.

Green Growth Toolbox: Instructional materials that explain how to do Green Growth, including a handbook, conservation data, and training workshops.

Habitat: See page 4.

Habitat Edge: The edge of a habitat adjoining incompatible land. For example, forest habitat edge adjoins grassland, crops or development and grassland habitat edge adjoins development or forest. Habitat edge causes 'edge effects' whereby species are negatively impacted due to edge conditions including a higher number of predators, such as outdoor cats. The width of edge effects differs for different species. See page 48.

Habitat Fragmentation: Habitat is reduced in size and separated from other habitat areas such that wildlife that require the habitat decline in abundance or become extinct locally. See page 82.

Interior Habitat: The habitat far from a habitat edge and of sufficient size to support a species or group (guild) of species. See page 48.

Invasive, Exotic Plants: Any plant species that does not occur naturally in North Carolina and poses serious threats to native ecosystems, due to the plant's propensity to spread rapidly and out-compete native plant communities. See page 101.

Natural Area or Community: An area containing mostly native plants and animals.

Natural Heritage Area (NHA): Terrestrial or aquatic sites that are of special biodiversity significance as defined by the North Carolina Natural Heritage Program. A site's conservation priority rating or significance may be due to the presence of rare species, rare or high-quality natural communities or other important ecological features. Maps of NHAs are updated quarterly. See page 22.

Natural Heritage Element Occurrence (NHEO): Occurrences of rare plants and animals, exemplary or unique natural communities and important animal groupings, as tracked and documented by the North Carolina Natural Heritage Program (NCNHP). Collectively, these plants, animals, natural communities and animal assemblages are referred to as "elements of natural diversity" or simply as "elements." Maps of NHEOs are maintained and distribut-

ed by the NCNHP and are updated quarterly. See page 24.

Natural Heritage Inventory Report: These reports are available for most North Carolina counties from the N.C. Natural Heritage Program website at www.ncnhp.org/web/nhp/searchable-publications. These reports are based on field surveys of public and private properties for which they have permission to survey. The reports are by county and document the details about Natural Heritage Natural Areas and other natural areas that are of critical importance to conserving the state's biodiversity.

Natural Resource-Based Land Use Patterns: See page 92.

Natural Resource Inventory: See Field Survey.

North Carolina Conservation Planning Tool: See page 20.

North Carolina Wildlife Action Plan: Every state wildlife agency develops a Wildlife Action Plan in compliance with a U.S. Congressional mandate. The plan identifies Species of Greatest Conservation Need, defines priority wildlife habitats, and offers a blueprint for fish and wildlife conservation in NC. It is updated every 10 years.

Prescribed Fire See page 4.

Priority Wildlife Species and Habitats: Identified and described in the N.C. Wildlife Action Plan, these are wildlife species and habitats most of which are declining and may become threatened with extinction if conservation actions are not taken. See page 19.

Riparian: Natural vegetation and forest along the banks of waterways.

Seep: A small spring or a wet place where water rises from the ground to the surface.

Small Wetland Community: See page 54.

Species of Greatest Conservation Need: Identified and described in the N.C. Wildlife Action Plan, these are wildlife species that are declining and may become threatened with extinction if conservation actions are not taken..

Sprawl: Low density development patterns where buildings and roads are not clustered and where travel by a car is required for most needs (i.e., uses are not mixed). See page 3.

Spring: Any natural flow of water from rock or soil onto land or into a body of surface water.

Subwatersheds: Smaller watersheds within larger watersheds. See page 74.

Terrestrial Species: Species of wildlife that spend most of their life cycle on land. In North Carolina, groups of terrestrial species include birds, reptiles, amphibians, mammals, and insects.

Vernal Pool: See Ephemeral Wetland above.

Wildlife Travel Corridor (Wildlife or Habitat Corridor): An area of land in a relatively natural state that is unimpeded by significant development disturbance, including roads, such that a particular species can travel between core habitats along the corridor. See page 92.

APPENDIX E
RECOMMENDED READING

In addition to the references listed in separate sections of this handbook, a number of other publications can provide more information on a Green Growth approach to planning. Selected references can be found below.

Integrating Conservation Science and Local Planning

Beatley, T. 2000. Preserving biodiversity: Challenges for planners. Journal of the American Planning Association 66 (1): 5 - 20.

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Esparza, A. X. and G.R. McPherson. 2009. A Planner's Guide to Natural Resource Conservation: The Science of Land Development Beyond the Metropolitan Fringe. New York: Springer.

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Peck, S. 1998. Planning for Biodiversity: Issues and Examples. Washington, D.C.: Island Press.

Pima County, Arizona. 2011. The Economic Benefits of Conservation. In: Pima County. Protecting our Land, Water and Heritage. 1st ed. p. 132 - 137.

What is Happening in Other States?

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Austin et al. 2004. Conserving Vermont's Natural Heritage: A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Waterbury, Vermont.

Azerrad, J. M., and Nilon, C. H. 2006. An evaluation of agency conservation guidelines to better address planning efforts by local government. Landscape and Urban Planning 77: 255-262.

Georgia Department of Natural Resources, Coastal Resources Division. Green Growth Guidelines. Available from: https://coastalgadnr.org/GGG.

Maine's Department of Inland Fisheries and Wildlife. 2003. Beginning with Habitat. Available from: www.beginningwithhabitat.org

Miller, N. A., Klemens, M. W., and Schmitz, J. E. 2005. Biodiversity Conservation through Local Land Use Planning: An Assessment of Needs and Opportunities in the New Jersey Townships of Chester, Lebanon and Washington. Bronx, NY: Metropolitan Conservation Alliance, Wildlife Conservation Society.

Minnesota Department of Natural Resources. 2007. Natural Resource Guide: A Guide to Using Natural Resource Information in Local Decision Making. Available from: www.dnr.state.mn.us/nrplanning/community/nrig.html

Pima County, Arizona. 2012. Sonoran Desert Conservation Plan. Available from: www.pima.gov/cmo/sdcp/index.html

Saving Special Places [Internet]. 1000 Friends of Florida. [cited 2013 Aug 8]. Available from: www.1000friendsofflorida.org

Strong, K. 2008. Conserving Natural Areas and Wildlife in Your Community: Smart Growth Strategies for Protecting the Biological Diversity of New York's Hudson River Valley. N.Y. Cooperative Fish and Wildlife Research Unit, Cornell University and N.Y. Department of Environmental Conservation, Hudson River Estuary Program. Ithaca, NY.

Washington Department of Fish and Wildlife Conservation. [Internet]. Priority Habitats and Species Program. Available from: http://wdfw.wa.gov/conservation/phs/

Western Issues: Growth. [Internet]. The Sonoran Institute. Available from: https://sonoraninstitute.org/card/growth-and-infrastructure/

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N.C. Wildlife Resources Commission. 2002. Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality. Available from: https://www.ncwildlife.org/Portals/0/Conserving/documents/2002_GuidanceMemorandumforSecondaryandCumulativeImpacts.pdf

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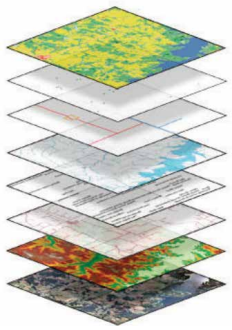
APPENDIX F
FURTHER GUIDANCE ON CONSERVATION PLANNING

There are a variety of conservation planning resources available with a large selection of map layers that are useful for planning. It would not be practical to include them all in Section 2 of this handbook so we summarize them in this appendix. The tools described here are most relevant for reference and supporting information at the planning stage and not at the level of development design. They contain a wide variety of map layers and analyses not found anywhere else. These resources communicate how important areas are to conserve and why, which can help to justify trying a conservation approach to land use and development in high priority areas.



The Conservation Planning Atlas and Conservation Blueprint

This tool is produced in our region by the Southeast Conservation Adaptation Strategy (SECAS). SECAS is a regional conservation initiative that uses data and stakeholder input to develop a spatial conservation plan that seeks to achieve a connected network of lands and waters to benefit ecosystems, species, and people in the Southeastern United States and Caribbean

- This spatial plan (and data download) is available through the Southeast Conservation Blueprint

Map layers and information include:

The Conservation Blueprint: "The blueprint" depicts and describes areas of highest to medium conservation priority, the amount of various land cover types and what types of wildlife and habitats are most in need of conservation within watersheds. It also a good resource for identifying ecological corridors for plants and wildlife.

The Atlas: The Atlas provides information and maps on basically any natural resource-related topic from economics to water quality. Types of maps and information include urban growth projections, watersheds by length of 303d streams, forest products, areas where priority wildlife species are likely to be found, habitat connectivity, and habitat quality.

Conservation Opportunity Areas

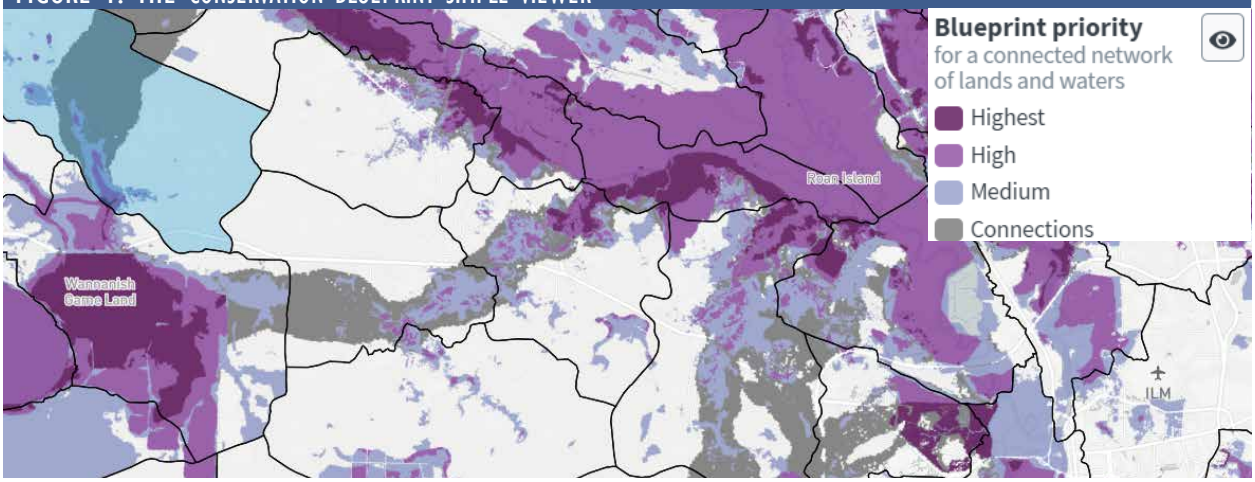
NATURE'S PICS *Northern flicker*

This resource was produced for the NC Wildlife Commission by NC State University. It depicts watersheds by the level of opportunity for conservation of wildlife Species of Greatest Conservation Need and priority habitats. Areas with more private unprotected land with declining habitat types rank higher in conservation opportunity. Information on the number and types of threats to wildlife and habitats is provided and can help guide decisions on what type of conservation measures to focus on. For example, communities could consider focusing land use or development policies and incentives on the highest priority habitat types in these high opportunity watersheds. A map of priority habitat types accompanies the opportunity areas map. This habitat map is not based on documented species occurrence and is a predictive model of what type of habitat is likely on the ground.

Examples of Using the Conservation Blueprint and the Atlas and in Planning

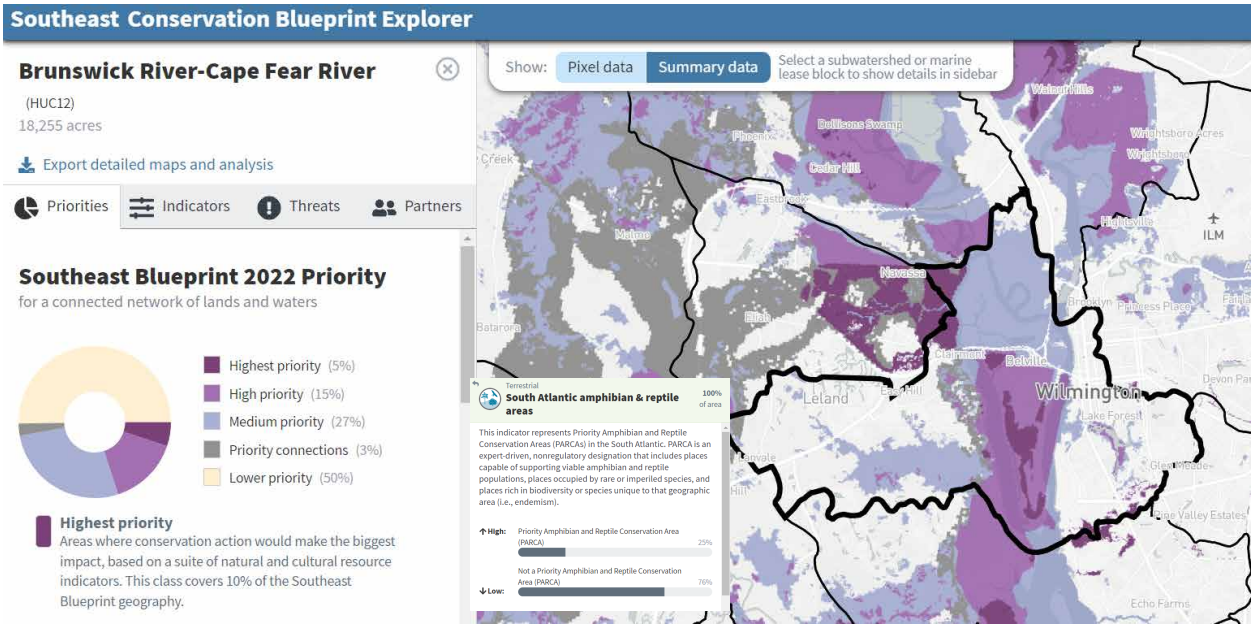
The map layers in the Conservation Blueprint and Atlas are updated annually, based on new data and input from stakeholders. This appendix was updated for the 2022 iteration of these resources.

FIGURE 1. THE CONSERVATION BLUEPRINT SIMPLE VIEWER



The Conservation Blueprint has a number of map layers within it that can be useful for planning. The Simple Viewer, shown in Figure 1 for the area north of Wilmington, identifies priorities for where conservation impact would make the biggest impact on ecological health, based on a number of indicators, such as the indicator shown in Figure 3. The Simple Viewer also identifies where there are connections, in gray, between large, high priority habitat areas, or 'hubs,' that wildlife probably use to travel between habitat hubs. These areas could be considered appropriate as a rural land use district with low overall density and cluster development in order to maintain habitat and connectivity.

FIGURE 2. THE CONSERVATION BLUEPRINT DETAILED ANALYSES BY WATERSHED



The Simple Viewer also includes a side panel, see Figure 2, which provides more detailed analysis of the underlying indicators that are used to identify conservation priorities, threats that that the area of interest face, and a list of conservation partners working in the region. These analyses provides an estimate of the percentage of land within a watershed that is a conservation priority and a list of indicators that show the percent of area of priority habitat types within a watershed. For example, in Figure 2, 25% of the area of the watershed outlined in black is estimated to support priority amphibian and reptile species. Five percent of this watershed is considered to be highest priority and 15% is high conservation priority. The Conservation Blueprint priorities are determined through stakeholder input and an analysis of many underlying data layers, termed 'indicators,' which can be viewed and downloaded through the Atlas. Figure 3 is an example of a map retrievable through the Atlas, where streams represented in darker shades of blue have a greater number of Species of Greatest Conservation Need observed.

FIGURE 3. EXAMPLE OF DATA AVAILABLE THROUGH THE ATLAS: IMPERILED AQUATIC SPECIES