Action Plan for the Lower Elk River Conservation Focus Area

September, 2023

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List of Acronyms Used

ACEP- Agricultural Conservation Easement Program
AMJV- Appalachian Mountain Joint Venture
BMPs- Best Management Practices
B-Rank- Biodiversity Rank
CFA- Conservation Focus Area
CCV- Cave Conservancy of the Virginias
CCVI- Climate Change Vulnerability Index
CERW- Cerulean Winged Warbler
CREP- Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CSP- Conservation Stewardship Program
EQIP- Environmental Quality Improvement Program
ESH- Early-successional Habitat
FSA- Farm Service Agency
G Rank- Global Rank
GWWA- Golden-winged Warbler
HUC- Hydrologic Unit Code
KCEMGA- Kanawha County Extension Master Gardeners' Association
KVMN- Kanawha Valley Master Naturalists
NRCS- Natural Resources Conservation Service
NWTF- National Wild Turkey Foundation
R8- Region 8
RGS- Roughed Grouse Society
SGCN- Species of Greatest Conservation Need
S Rank- State Rank
SWAP- State Wildlife Action Plan
TNC- The Nature Conservancy
TU- Trout Unlimited
USDA- United States Department of Agriculture
USFWS- United States Fish and Wildlife Service
WVACS- West Virginia Association of Cave Studies
WVCA- West Virginia Conservation Agency
WVCC- West Virginia Cave Conservancy
WVDHHR- Department of Health and Human Resources
WVDNR- West Virginia Division of Natural Resources
WMA- Wildlife Management Area
WVDEP- West Virginia Department of Environmental Protection
WVDOF- West Virginia Division of Forestry
WVDOH- West Virginia Division of Highways
WVRC- West Virginia Rivers Coalition
WVU- West Virginia University

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups, cave interest groups and other non-profit conservation organizations working in the area to develop this Action Plan for the Lower Elk River CFA. This Action Plan addresses the eight essential elements required in the SWAP. It provides an overview of the landscape and major habitat types within this CFA, including forest and woodland habitats and aquatic, floodplain and riparian habitats. It also identifies 122 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the Action Plan lists the priority species, stresses and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. A plan for implementation for each major habitat type lists partners and programs available to assist with each of the actions and metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The Action Plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience and outlines next steps in plan implementation.

Local stakeholders can use this plan to identify priority species, the habitats and stresses within the CFA, as well as partners who can assist with planning, implementation and monitoring of conservation actions to conserve wildlife and enable climate adaptation. The information in this plan can also be used to inform conservation projects being planned by partners and provide justification for grant applications and other proposals seeking to conserve priority species and habitats. Local stakeholders can also work with relevant agencies to develop strategies to avoid, minimize and mitigate impacts to priority species, their habitats and the resilient and connected landscapes within this CFA.

Conserving wildlife species and their habitat within this CFA will rely upon the voluntary actions of local landowners, public agencies and partner organizations, with support from the WVDNR. WVDNR will convene a working group of local stakeholders on a regular basis to provide guidance, assistance and support the plan, implement and monitor conservation actions, facilitate stakeholder collaboration and update the Action Plan every 10 years or sooner if needed.

Introduction to the State Wildlife Action Plan & Conservation Focus Areas

The West Virginia Division of Natural Resources (WVDNR) manages the state's wildlife resources as part of the public trust. A goal of the WVDNR is to support and promote a sense of ownership in the conservation community and the public for the unique habitats and wildlife resources in West Virginia. The 2015 WV State Wildlife Action Plan (SWAP) was therefore developed to function as a blueprint for conservation for use by other natural resource agencies, local governments, non-governmental organizations and the general public (WVDNR 2015). The SWAP is intended to have a ten-year timeframe and will be updated by 2025.

Species of Greatest Conservation Need, Habitats and Stresses

The 2015 SWAP identified 681 wildlife Species of Greatest Conservation Need (SGCN) across the state. Because plants are a fundamental element of habitat for wildlife SGCN, a list of SGCN plants was also developed, including 482 plant species.

The SWAP classified and mapped 19 terrestrial habitats across the state. These include 16 natural or semi-natural habitats that are derived from NatureServe's Ecological Systems (Comer et al., 2003, Gawler 2008) and 3 anthropogenic habitats that represent map classes of the National Land Cover Database (Homer et al. 2004). In addition, the SWAP classifies and maps 18 aquatic habitat types. These are GIS-derived types based on a simplification for West Virginia of the Northeast Aquatic Habitat Classification System (Anderson et al. 2013). Stream size is considered the most influential variable on determining biological assemblages at the reach scale and is divided into four primary classes: headwaters and creeks, small rivers, medium rivers and large rivers. Stream slope, or gradient, affects aquatic communities at the reach scale due to its influence on stream bed morphology, water velocity and sediment dynamics. Three relative classes (low, moderate, high) of gradient are used to define West Virginia's streams. Water temperature in streams is a key physiological characteristic determining where different stream organisms may persist. Temperature affects seasonal migrations, growth rates, body condition and fecundity of biota. Three temperature classes (cold, cool, warm) based on continuously recorded data and modeled environmental variables were used to determine biological constraints on stream communities in the model. The characteristics, distribution, trends and threats associated with each of the terrestrial and aquatic habitats are described in the 2015 SWAP.

For those SGCN listed in the SWAP and their associated habitats, WVDNR staff developed a statewide stress assessment using the classification system of the International Union for Conservation of Nature. Terrestrial stresses were addressed at the habitat level within ecoregions. Aquatic stresses were addressed at the HUC 8 watershed level within ecoregions. The resulting analysis identified 21 major statewide stresses affecting terrestrial SGCN and habitats and 21 major stresses that affect aquatic SGCN and habitats. Stresses exerted on SGCN populations and habitats can reduce species populations either directly, by causes such as disease, or indirectly, by affecting the quality or quantity of available habitat.

Conservation Actions

The purpose of stress assessment and prioritization in the 2015 SWAP is to identify statewide conservation actions that can reduce stress on SGCN populations and their habitats. Most stresses are the result of the lawful activities of people, corporations and public agencies. Rather than seeking a regulatory approach to

restrict lawful activities, the intent of the SWAP is to promote collaboration with landowners, corporations and other partner organizations and agencies to reduce stresses on wildlife species and their habitats.

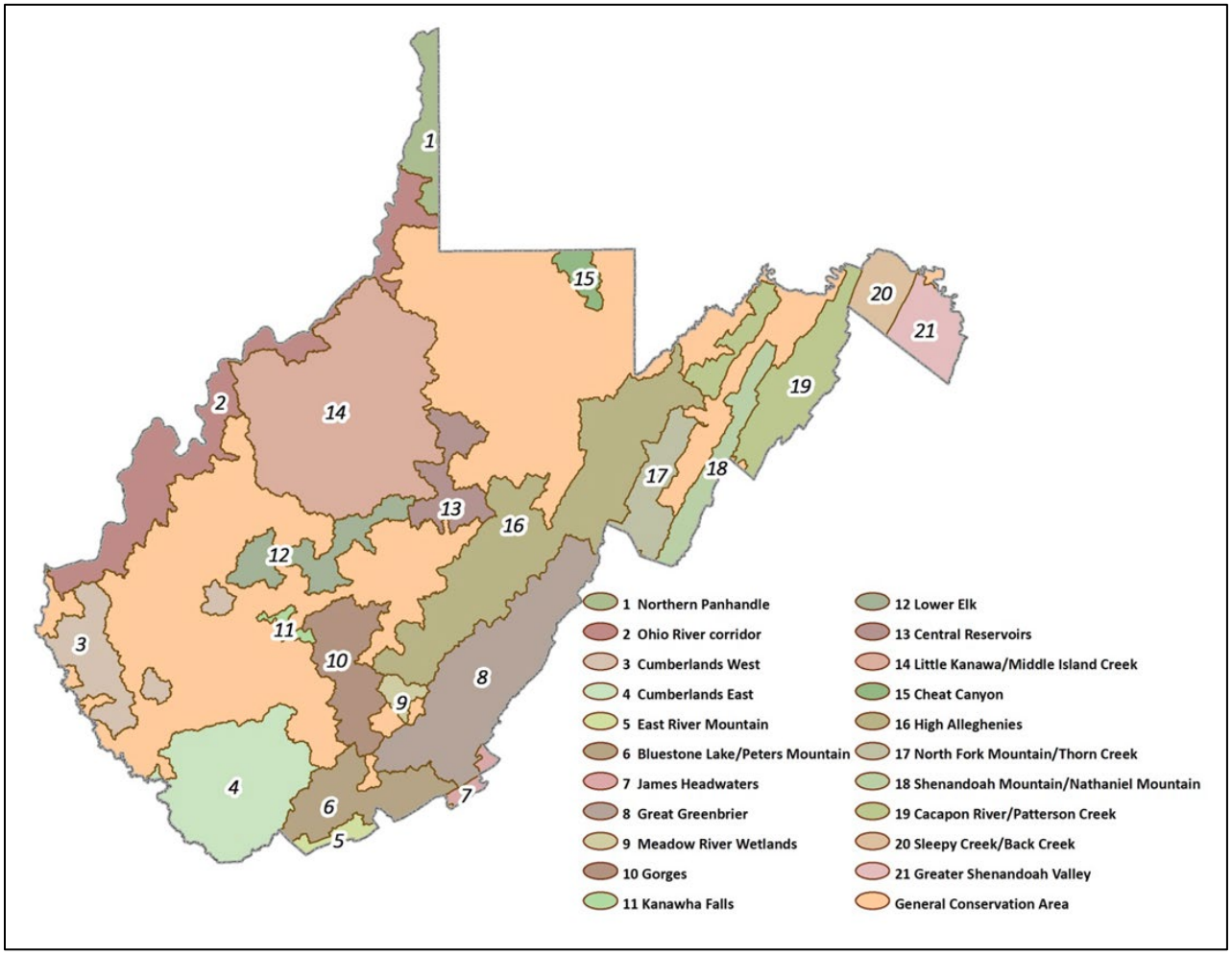
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve directly protecting or restoring habitats or even restoring populations. Conservation easements are a form of habitat protection that preserves habitat in its current state or can include land management plans that benefit wildlife. It is likely that a suite of actions is required depending on the identified stress and the opportunities available. Ideally, actions are designed to address the source of the stress (AFWA 2011). Conservation actions must also address habitat integrity and ecosystem processes. This includes conserving or preserving intact and functional habitats, protecting or restoring aquatic resources and maintaining and restoring connectivity between habitats (AFWA 2012, Byers and Norris, 2011).

Conservation Focus Areas and Action Plans

The SWAP provides a broad framework for conservation across West Virginia. However, wildlife species are concentrated in different parts of the state and exposed to multiple stresses at state, regional and and local scales. Conservation Focus Areas (CFAs) are specific regions in the state where SGCNs are concentrated, addressable threats are identified and where feasible opportunities exist for focused actions that will achieve success. In completing the 2015 SWAP, WVDNR defined 21 CFAs across the state based on these factors. Map 1 on the following page illustrates the CFAs in West Virginia.

In addition to conservation actions at the statewide level, the 2015 SWAP envisioned that planning at the CFA level would be necessary to fully implement successful conservation and to further define conservation actions and measurable outcomes for most SWAP-based activities. The SWAP also notes that investing conservation resources in the CFAs could increase the potential for collaboration with partners and landowners, as well as the efficiency and effectiveness of conservation on the ground. CFA Action Plans have been developed to identify priority SGCN from each taxa group in each major habitat type, key stresses in those habitats and actions that will effectively secure or protect priority species and their habitats within the CFA. The Plans also identify public lands that can provide opportunities for conservation in collaboration with public land managers. Because many SGCN and their habitats occur on private property within CFAs, conservation actions will require collaboration with private landowners, as well as partner organizations and stakeholder groups. Many local partners have relations with landowners as well as the expertise, capacity, resources and funding to plan and implement the actions listed in CFA Action Plans. CFA planning engages local partners and stakeholders at a scale where collaboration can increase resources (funding, capacity) available for conservation action. WVDNR has engaged a working group of local partners in developing each CFA Action Plan and intends to facilitate, guide and support partner efforts in planning, implementation and evaluation of conservation actions to implement the plans.

Map 1. Conservation Focus Areas in West Virginia.



Climate Change and Resilience

The 2015 SWAP lists climate change as a substantial threat to wildlife and plant populations, noting several recent studies. For example, an assessment of the relative vulnerability to climate change of 185 animal and plant species in West Virginia (Byers and Norris, 2011) identified natural and anthropogenic barriers to movement and dispersal and physiological thermal and hydrological niches occupied by some species as risk factors correlated with vulnerability to climate change. Over half of the species assessed were determined to be vulnerable to climate change. Both this study and the SWAP identify climate change as a stressor particularly for cool and coldwater fish, mollusks, plants, terrestrial salamanders and many species associated with wetlands and high elevation ecosystems. The SWAP lists habitat shifts and alterations as statewide stresses for terrestrial SGCNs and it lists increasing frequency and severity of droughts, storms and flooding and temperature extremes as statewide stresses for aquatic SGCN and habitats. The SWAP notes that even within taxonomic and habitat groupings, species may respond differently to climate change based on their sensitivity to factors such as temperature, moisture and seasonal triggers. Because climate change acts in tandem with other stresses on wildlife and habitat, the SWAP suggests that actions to address those other stresses could decrease their vulnerability to climate change. Varying conditions among CFAs means actions to address climate impacts should be tailored to each CFA, emphasizing restoration and expansion of vulnerable habitat types in some areas, or reducing habitat fragmentation in

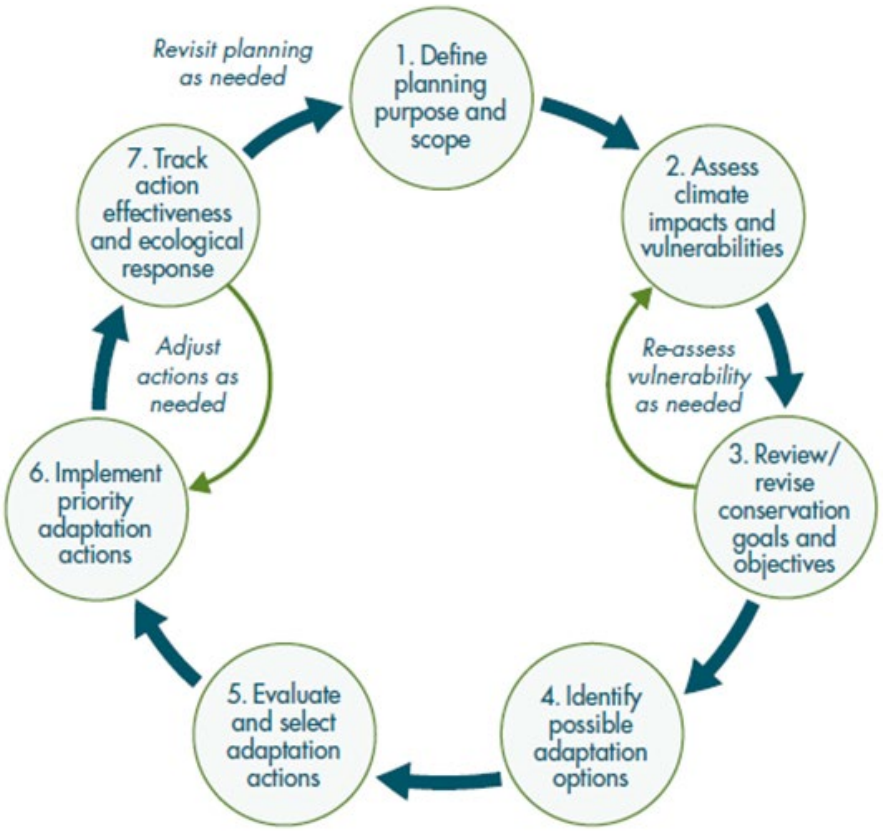
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, the SWAP therefore seeks to address climate change broadly through additional vulnerability assessments for select species, statewide actions to reduce additional stresses on SGCNs and their habitats and more geographically focused actions in Conservation Focus Areas (CFAs). CFAs are an appropriate scale to promote climate resilience by identifying local actions to relieve stresses on SGCN, restore or expand vulnerably habitats and maintain ecosystems process, landscape resilience and habitat connectivity.

Monitoring and Adaptive Management

Monitoring of SGCNs and their habitat is essential to establish better baseline data about species distribution, abundance and population trends. The SWAP calls for monitoring of species and habitat trends across the state, along with more-intensive monitoring within CFAs through collaboration with local partners to gain more area-specific data and to address local threats with targeted conservation actions.

Beyond monitoring SGCNs and their habitat, successful wildlife conservation in CFAs will require monitoring the effectiveness of conservation actions and adapting those actions accordingly. The SWAP envisions monitoring the results of conservation actions at the CFA level and that CFA-level plans should incorporate measurement and monitoring protocols integrated with conservation actions themselves. Effectiveness measures indicate progress to date and whether the expected results are being realized. Conservation actions should be designed with enough specificity that project impacts and performance can be measured but broadly enough to benefit multiple species and engage partners. Success may be measured by the amount of protected or restored habitat, by stability or increase in populations, or by the acquisition of the information required to make informed conservation decisions. Another measure of success is the amount of “buy-in” or participation by conservation partners in the public and private sectors. Conservation partners, especially those operating through grant funding or those following conservation agency protocols, may already have metrics for accomplishment/success that are used for their own reporting requirements. Furthermore, accountability and transparency to funding sources, partners and the public are essential for program success.

Adaptive management also requires monitoring of climate change impacts on species and their habitats, as well as the success of conservation actions. In common terms, climate adaptation may be thought of as preparing for, coping with, or adjusting to climatic changes and their associated impacts (Stein et al., 2014). Frameworks such as the Climate Smart Conservation Cycle illustrated below (from Stein et al., 2014) can be used to plan, implement and monitor conservation actions to enable wildlife to adapt to a changing climate. Planning conservation actions to implement this plan should consider climate impacts to species and habitats, WVDNR’s ongoing vulnerability assessments and field surveys to further document population trends, distribution and abundance of priority species and the options to build the resilience of each major habitat type listed in this Action Plan. Information on site conditions and project plans provided by partners and landowners should also be considered. This will require careful coordination among WVDNR and local stakeholders.



Climate-Smart Conservation Cycle
A General Framework for Adaptation Planning and Implementation
Stein et. al, 2014

Organization of this Action Plan

This CFA Action Plan will begin by introducing the CFA, including an overview of the landscape, terrestrial and aquatic habitats, species of greatest conservation need, distinctive stresses and broad conservation actions, potential partners and lands protected by public ownership or conservation easements. The plan then reviews the conservation goals and lists priority species identified by WVDNR specialists based on factors such as their abundance, population trends and opportunities for conservation within the CFA. The plan is then divided by major habitat type, including forest and woodland habitats, and aquatic, floodplain and riparian habitats. For each major habitat type the plan lists priority species, stresses effecting those species and actions to alleviate those stresses. The plan also identifies climate stresses impacting each major habitat type and lists potential actions to boost their resilience. The plan provides a roadmap for implementation and monitoring of conservation actions for each major habitat type and brief statements about other human benefits that may be generated by the proposed actions. The plan also describes a regional network of resilient and connected landscapes spanning multiple habitat types that enable wildlife species to adapt and shift to a changing climate and provides an implementation plan for landscape resilience and connectivity. The conclusion provides a summary of the priority habitats for conservation, describes the importance of integrating conservation for greater impact, connecting conservation actions for climate resilience and outlines next steps in plan implementation.

How to use this plan

Implementation of this Action Plan will rely upon voluntary actions by local stakeholders including landowners, public agencies and partner organizations, and collaboration between them to conserve wildlife species and their habitat. The role of WVDNR in implementing this plan is to provide local stakeholders with information, guidance, assistance and support to develop, implement and monitor conservation actions, and facilitate stakeholder collaboration.

Local stakeholders can use this plan for many purposes, including the following:

- Identify priority wildlife species, rare plant communities and their habitats, and the resilient and connected landscapes that can enable species to shift in response to changing conditions.
- Work with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to priority species, their habitats and the resilient and connected landscapes.
- Identify stresses on priority species in specific habitats, conservation actions that can alleviate those stresses, monitoring protocols to evaluate success and partners who can provide assistance.
- Understand climate impacts on wildlife habitat and actions to boost habitat resilience.
- Plan and implement conservation actions to boost habitat resilience and enable wildlife to adapt to climate change.
- Design and implement monitoring protocol to evaluate the success of conservation actions.
- Inform and provide rationale for activities being proposed in grant or permit applications.
- Integrate priority species, habitat and climate resilience into other local project plans.

The information provided in this Action Plan is constantly evolving. Local stakeholders are encouraged to seek additional information and assistance from WVDNR to:

- Confirm whether specific priority wildlife species and habitats are present at specific sites
- Understand species and habitat vulnerability to climate change
- Further define or confirm stresses on wildlife species and habitats
- Tailor proposed wildlife conservation actions to alleviate stresses
- Consider adaptation options to boost habitat resilience to climate change
- Develop effective strategies to monitor and evaluate project success

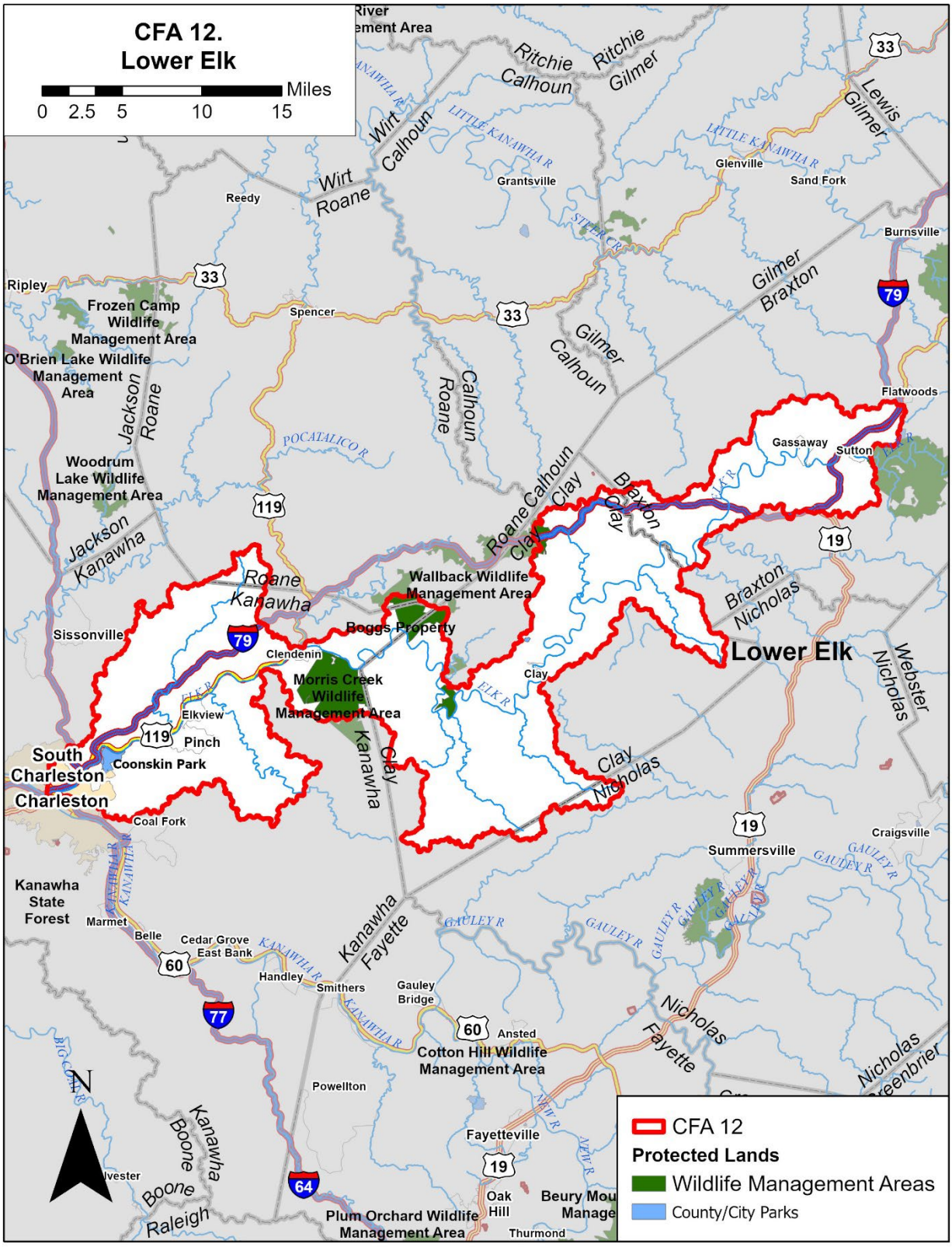
Lower Elk River Conservation Focus Area

Overview

The Lower Elk River Conservation Focus Area (CFA) is that portion of the river from below Sutton Dam to its confluence with the Kanawha River and surrounding uplands, stretching along the juncture of the Western Allegheny Plateau and Cumberland Mountains ecoregions. The river, met by many small to medium tributaries, meanders across a hilly, dissected low sandstone plateau, with ridge crests usually well below 2000 feet. West Virginia's largest city, Charleston, occurs at the mouth of the Elk, but for much of its length, the lower Elk passes by small towns and farms.

In this deeply dissected region of West Virginia, the river valley is used as a transportation corridor, with either roads or railroads, and often both, running along both sides. The uplands remain primarily forested, with the original Mixed Mesophytic Forest generally highly fragmented, but several moderate sized forest blocks remain. Forestland is mostly in small to medium- sized non-industrial, private holdings, but there are some medium-sized industrial timber holdings. Oil and gas wells and coal mines are widespread in the uplands. Characterized by its excellent water quality, the Elk River provides drinking water to several communities including Charleston, and maintains highly diverse and abundant fish and mussel populations.

Map 2. Overview



Habitats

The Lower Elk River CFA includes a variety of forest, aquatic, floodplains and riparian habitat types.

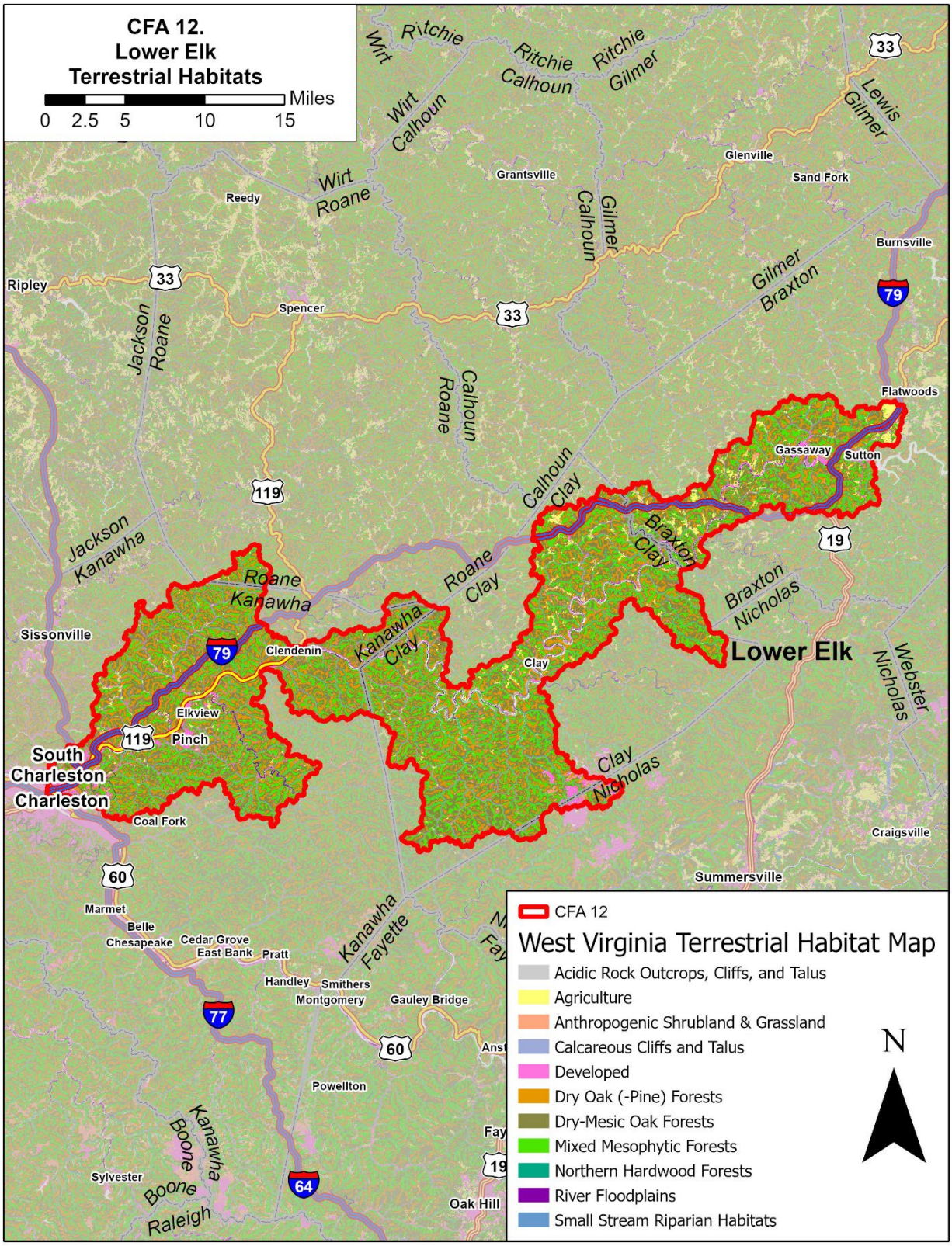
Terrestrial Habitats

Eleven of the habitat types described in the SWAP are present in this CFA. Most of the CFA is covered by various forest types, with small amounts of rocky and riparian habitats, as well as developed and agricultural lands scattered throughout the area. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat Type	Acres in CFA	% of Areas in CFA	% of WV Total for Type
Acidic Rock Outcrops, Cliffs and Talus	1,688	0.54%	1.88%
Agriculture	8,092	2.61%	0.56%
Anthropogenic Shrubland & Grassland	2,111	0.68%	1.33%
Calcareous Cliffs and Talus	16	0.01%	0.17%
Developed	26,559	8.57%	2.33%
Dry Oak (-Pine) Forests	62,893	20.29%	2.55%
Dry-Mesic Oak Forests	113,195	36.51%	2.27%
Mixed Mesophytic Forests	82,620	26.65%	2.80%
Northern Hardwood Forests	36	0.01%	0.00%
River Floodplains	1,973	0.64%	1.64%
Small Stream Riparian Habitats	7,736	2.50%	1.57%
Unresolved	3,092	1.00%	2.65%
Totals	**310,012**	**100.00%**	

Map 3. Terrestrial Habitats



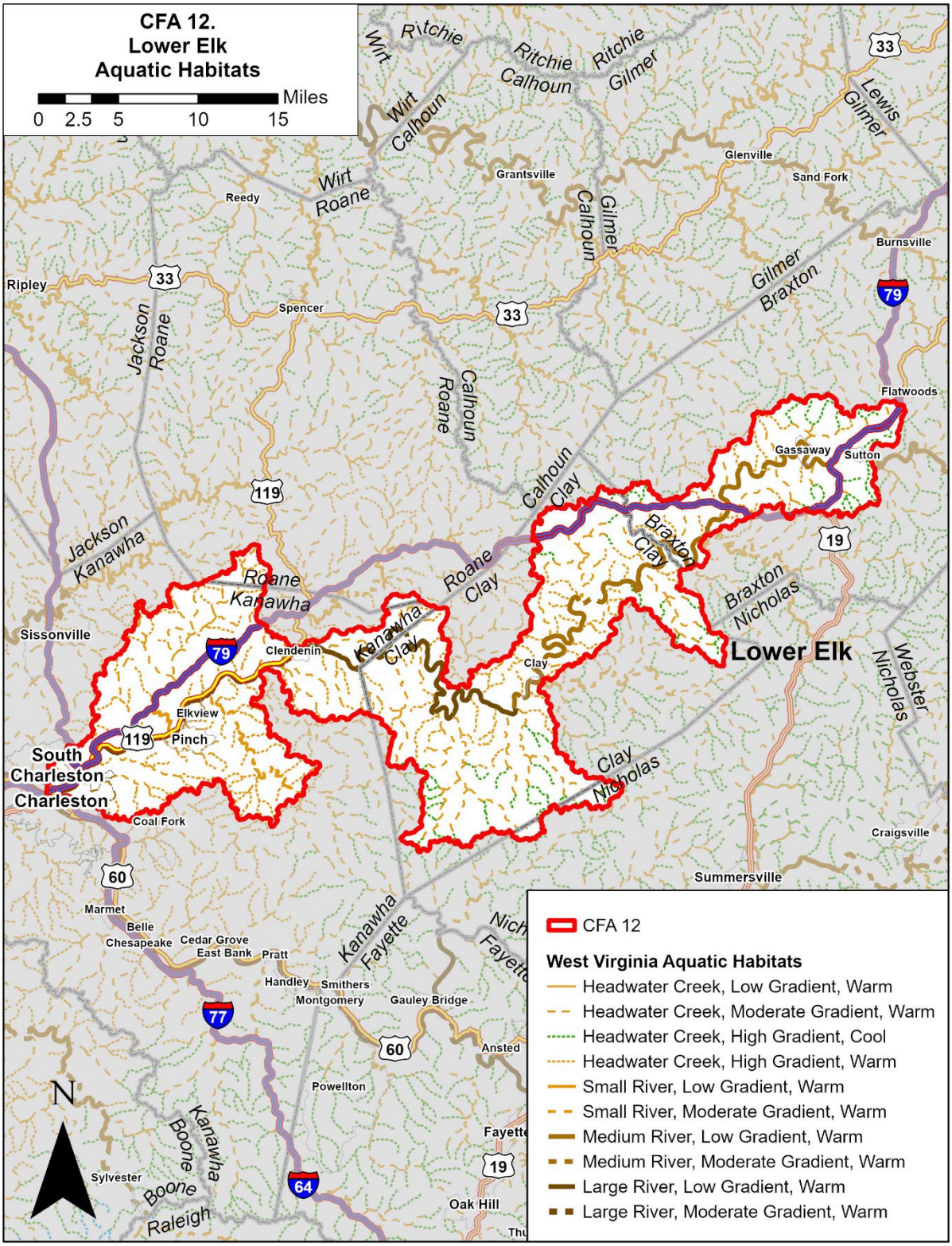
Aquatic Habitats

Ten of the aquatic habitat types described in the SWAP are present within the Lower Elk River CFA, including nearly 30% of the state's warm, high gradient headwater creek habitat. Aquatic habitats are described in Chapter 3 of the 2015 SWAP.

Table 2. Aquatic Habitat Summary

Habitat Type	**Miles in CFA**	**% of CFA Area**	**% of WV Total for Type**
Headwater Creek, Low Gradient, Warm	10	1.49%	1.76%
Headwater Creek, Moderate Gradient, Warm	232	35.31%	5.94%
Headwater Creek, High Gradient, Cool	75	11.36%	1.19%
Headwater Creek, High Gradient, Warm	217	33.04%	28.57%
Small River, Low Gradient, Warm	7	1.09%	1.55%
Small River, Moderate Gradient, Warm	15	2.29%	2.77%
Medium River, Low Gradient, Warm	46	6.98%	9.64%
Medium River, Moderate Gradient, Warm	6	0.86%	1.64%
Large River, Low Gradient, Warm	45	6.81%	7.69%
Large River, Moderate Gradient, Warm	5	0.77%	4.63%
Totals	**657**	**100.00%**	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa listed in the SWAP for the Lower Elk River CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	5
Birds	22
Butterflies and Moths	3
Crayfish	1
Dragonflies and Damselflies	7
Fish	25
Mammals	7
Mussels	31
Plants	8
Reptiles	6
Snails	7
Tiger Beetles	1
Total	**123**

The Lower Elk River is one of the most biologically significant watersheds in the Ohio River system. It has one of the richest diversities of freshwater mussels in the state with 31 SGCN species, five of which are federally listed. Queen Shoals is a location where federally endangered mussel species restoration is being conducted. The once extirpated Rayed Bean was reintroduced in 2006 and augmentation of the small existing Northern Riffleshell population began in 2012. Spread Shoals near Mary Chilton Roadside Park is another special location for snorkeling to observe the diversity of darters in this river.

The Elk River also hosts a diverse fish community with 98 fish species documented, including the only extant population remaining anywhere of the federally endangered Diamond Darter and 24 other SGCN fishes. Streams and wetlands in the CFA support seven SGCN dragonflies and damselflies. Forested uplands support populations of forest interior bird species, with some of the highest suspected breeding densities of Cerulean Warbler anywhere in the country and the northernmost breeding extent of Swainson's Warbler in the state.

This Action Plan will list the priority SGCN in each major habitat type in the CFA.

Distinctive Stresses

The 2015 SWAP lists several general stresses affecting SGCN and habitat in this CFA:

- Energy development contributes to habitat loss, forest fragmentation, water pollution and acid mine drainage. Additional water pollution problems arise from industrial and sewage discharges and spills.
- The Elk River is a warmwater stream. Although Sutton Dam has a multilevel release, high flows in the summer significantly reduce water temperatures when the dam is forced to release a large portion of its discharge from the bottom port. Cooler water temperatures impact mussel reproduction.
- In 2014 a mussel kill was observed in the upper reaches of the lower Elk.
- No freshwater mussel reproduction has been observed in this area in over ten years.
- Significant algae blooms occur between Duck and Ivydale.

This Action Plan will list additional local stresses affecting priority SGCN in each major habitat type.

Conservation Actions

To address these stresses, the 2015 SWAP recommended these main types of action in the CFA, listed below.

- Engage with the public and especially local watershed and environmental groups, to instill awareness and concern for the aquatic resources.
- Partner with local watershed groups and local governments to elevate efforts to reduce water pollution and avoid future spills.
- Partner with land managers (public and private) to implement forest management practices that benefit forest interior birds.
- Identify factors impacting mussel reproduction and creating algae blooms and develop corrective strategies.

This Action Plan will list additional conservation actions to address the stresses affecting priority SGCN in each major habitat type.

Potential Partners

The 2015 SWAP lists many potential partners for landowners and others interested in wildlife conservation in the CFA, including:

- WV Department of Environmental Protection
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Watershed groups
- Natural Resources Conservation Service
- Appalachian Mountains Joint Venture

With an established “constituency”, many conservation partners can provide direct outreach to landowners and key stakeholders interested in wildlife conservation. The WVDNR will engage with these and other partners in regular face-to-face meetings during CFA planning, as well as plan implementation

and monitoring. In many cases partners may assume a lead role in implementing the conservation actions. Appendix 5 lists the types of programming and assistance each partner provides to landowners. Specific partners are also listed along with conservation actions supported through their programs in the implementation plan for each habitat type.

Protected Lands

Public lands that may provide significant opportunities for wildlife conservation include:

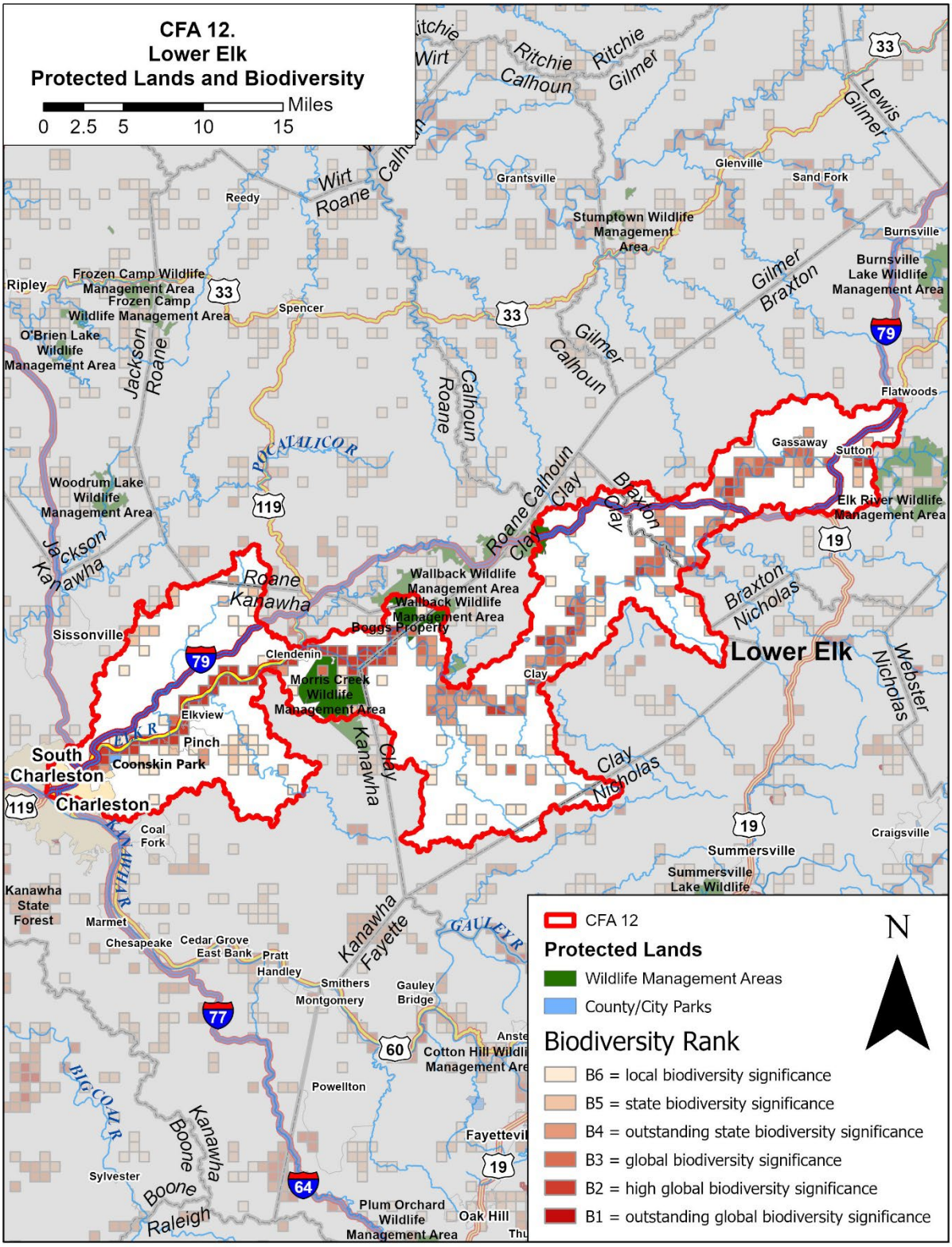
- Morris Creek WMA
- Wallback WMA
- Coonskin Park
- Elk River Trail

The Elk River Trail was an addition to the WV State Parks system in 2023, and currently stretches over 73 miles from Clendenin to Gassaway.

These public lands provide important wildlife habitat and are managed for conservation or other compatible goals. Appendix 3 lists habitat types occurring in each of the public lands within this CFA. WVDNR will work with public land managers to identify opportunities to plan and implement conservation actions that address stresses in these habitats and support priority SGCN. On state lands, this can include protection of important ecosystems, habitats, SGCN populations or plant communities through designation as State Natural Areas. City and county-owned public lands may also be managed to benefit wildlife and habitat.

Map 5 shows the location of public lands and conservation easements in the CFA, based on data provided by The Conservation Fund (TCF), USGS Gap Analysis Program (GAP), The Nature Conservancy (TNC) and the National Conservation Easement Database (NCED) in 2015. It also shows known occurrences of SGCN and rare plant communities within 1- square kilometer areas and the biodiversity rank (including global, state, or local significance) of those occurrences, as generated by WVDNR in 2017. This map illustrates that many SGCN and rare plant communities occur on public lands and along the Elk River and there may be opportunities for WVDNR, public agencies and landowners to protect them there. Many SGCN and rare plant communicates also occur on private land outside of public lands and conservation easements. This indicates how important it is for WVDNR and other partners working with private landowners to restore and protect biodiversity on private lands. Appendix 5 lists partners and programs that provide assistance to private landowners in wildlife conservation.

Map 5. Protected Lands and Biodiversity



Action Plan for the Conservation Focus Area

Conservation Goals

This CFA Action Plan is an extension of the State Wildlife Action Plan. While it is driven by local issues, the overarching goals remain the same. These include:

1. Halt the decline of at-risk species and thus avoid the need for federal listing as threatened or endangered
2. Assist with the recovery of federally listed species
3. Keep common species common
4. Conserve the full array of habitat types and biological diversity in the state

The WVDNR will collaborate with agency partners, non-governmental organizations and the public to address threats to Species of Greatest Conservation Need, key habitats and unique communities.

Priority Species

Effectiveness and efficiency are paramount in targeting actions in CFAs and specifically addressing every SGCN present in the CFA is not feasible. From the list of SGCNs documented in the CFA as provided in the SWAP, WVDNR biologists selected priority species for conservation action that represent the best opportunity for successful conservation based on:

- their conservation status and known trends globally, across the state and in the CFA;
- the degree of dependence of each species on habitats within the CFA;
- the degree to which conservation activities to protect targeted species will also benefit a suite of other species occupying the same habitat or niche;
- conservation opportunities and likelihood of conservation success in the CFA;
- and other factors.

Table 4 lists SGCNs that were selected as priorities within the CFA based on the above criteria.

Additional field surveying and information is needed to document and monitor the distribution, abundance and population trends of these priority species in the habitats where they occur and to assess their vulnerability to climate change. This work is ongoing.

Table 4. Priority Species in the CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5
Birds	Bonasa umbellus	Ruffed Grouse	S3B,S3N	G5
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5
Birds	Limnothlypis swainsonii	Swainson's Warbler	S3B	G4
Birds	Megaceryle alcyon	Belted Kingfisher	S3B	G5
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4
Birds	Spizella pusilla	Field Sparrow	S3B, S3N	G5
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5
Butterflies & Moths	Euphydryas phaeton	Baltimore Checkerspot	S3S4	G4
Fish	Ammocrypta clara	Western Sand Darter	S1	G3
Fish	Ammocrypta pellucida	Eastern Sand Darter	S3	G3
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4
Fish	Crystallaria cincotta	Diamond Darter	S1	G1
Fish	Etheostoma maculatum	Spotted Darter	S1	G2
Fish	Etheostoma tippecanoe	Tippecanoe Darter	S2	G3G4
Fish	Ichthyomyzon fossor	Northern Brook Lamprey	S1	G4
Fish	Lethenteron appendix	American Brook Lamprey	S2	G4
Fish	Notropis ariommus	Popeye Shiner	S2	G3
Fish	Noturus eleutherus	Mountain Madtom	S2	G4
Fish	Noturus stigmosus	Northern Madtom	S1	G3
Fish	Percina macrocephala	Longhead Darter	S2	G3
Fish	Polyodon spathula	Paddlefish	S1	G4
Mussels	Elliptio crassidens	Elephant-ear	S2	G5
Mussels	Epioblasma triquetra	Snuffbox	S2	G3

Taxa	Scientific Name	Common Name	S Rank	G Rank
Mussels	Fusconaia subrotunda	Long-solid	S3	G3
Mussels	Lampsilis abrupta	Pink Mucket	S1	G2
Mussels	Paetuliunio fabalis	Rayed Bean	S1	G2
Mussels	Pleurobema clava	Clubshell	S1	G2
Mussels	Theliderma cylindrica	Rabbitsfoot	SX	G3G4
Plants	Carex kraliana	Kral's Sedge	S1	G5
Plants	Carex lucorum var. austrolucorum	Blue Ridge Sedge	S1	G4T3T5
Plants	Hypericum drummondii	Nits-and-lice*	S1	G5
Plants	Lygodium palmatum	American Climbing Fern	S3	G4
Plants	Scleria oligantha	Little-head Nutrush	S1	G5
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	G5T5

*Species present in historical records. Surveying required to determine current status.

S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

Forest and Woodland Habitats

Dry Mesic Oak, Mixed Mesophytic, and Dry Oak (Pine) Forests compose much of the landscape within the Lower Elk River CFA, covering over 70% of the total area collectively. Northern Hardwood Forests occur in small parcels (30 acres or less) north of Gassaway and east of Clendenin. Many dry forest types are threatened by invasive species, mesophication (gradual moistening) and lack of fire, while overbrowsing by deer reduces regeneration of oak and other palatable understory species. Maps 6 and 7 display forest habitat types and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity within the CFA. The diversity of forest types across elevational gradients provides great opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches may provide core habitat for priority SGCN and rare communities, as well as a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change. Large, intact forest blocks support forest interior breeding birds, including Wood Thrush, Cerulean Warbler and Worm-eating Warbler. Early successional and forest edge habitats and semi-wooded agricultural or floodplain habitats support species such as Ruffed Grouse, Eastern whip-poor-will and Field Sparrow.

Embedded within the forested landscapes of this CFA, small areas of acidic rock outcrops, cliffs and talus habitat are concentrated along the Elk River and southern parts of the CFA. Calcareous cliffs and talus are also present in more northern portions of the CFA. These habitats are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Map 8 illustrates the location of these rare habitats. Rock outcrop, cliff and talus habitats require careful management and those in smaller forest patches may be more vulnerable to stresses.

Priority Species

The following priority species in the CFA are associated with forest and woodland habitats.

Table 5. Priority Species in Forest and Woodland Habitats.

Taxa	Scientific Name	Common Name
Birds	Antrostomus vociferus	Eastern Whip-poor-will
Birds	Bonasa umbellus	Ruffed Grouse
Birds	Buteo platypterus	Broad-winged Hawk
Birds	Geothlypis formosa	Kentucky Warbler
Birds	Helmitheros vermivorum	Worm-eating Warbler
Birds	Hylocichla mustelina	Wood Thrush
Birds	Icteria virens	Yellow-breasted Chat
Birds	Limnothlypis swainsonii	Swainson's Warbler

Taxa	Scientific Name	Common Name
Birds	Setophaga cerulea	Cerulean Warbler
Birds	Spizella pusilla	Field Sparrow
Birds	Vermivora cyanoptera	Blue-winged Warbler
Plants	Carex kraliana	Kral's Sedge
Plants	Carex lucorum var. austrolucorum	Blue Ridge Sedge
Plants	Lygodium palmatum	American Climbing Fern
Plants	Scleria oligantha	Little-head Nutrush
Reptiles	Terrapene carolina carolina	Eastern Box Turtle

Rare Plant Communities

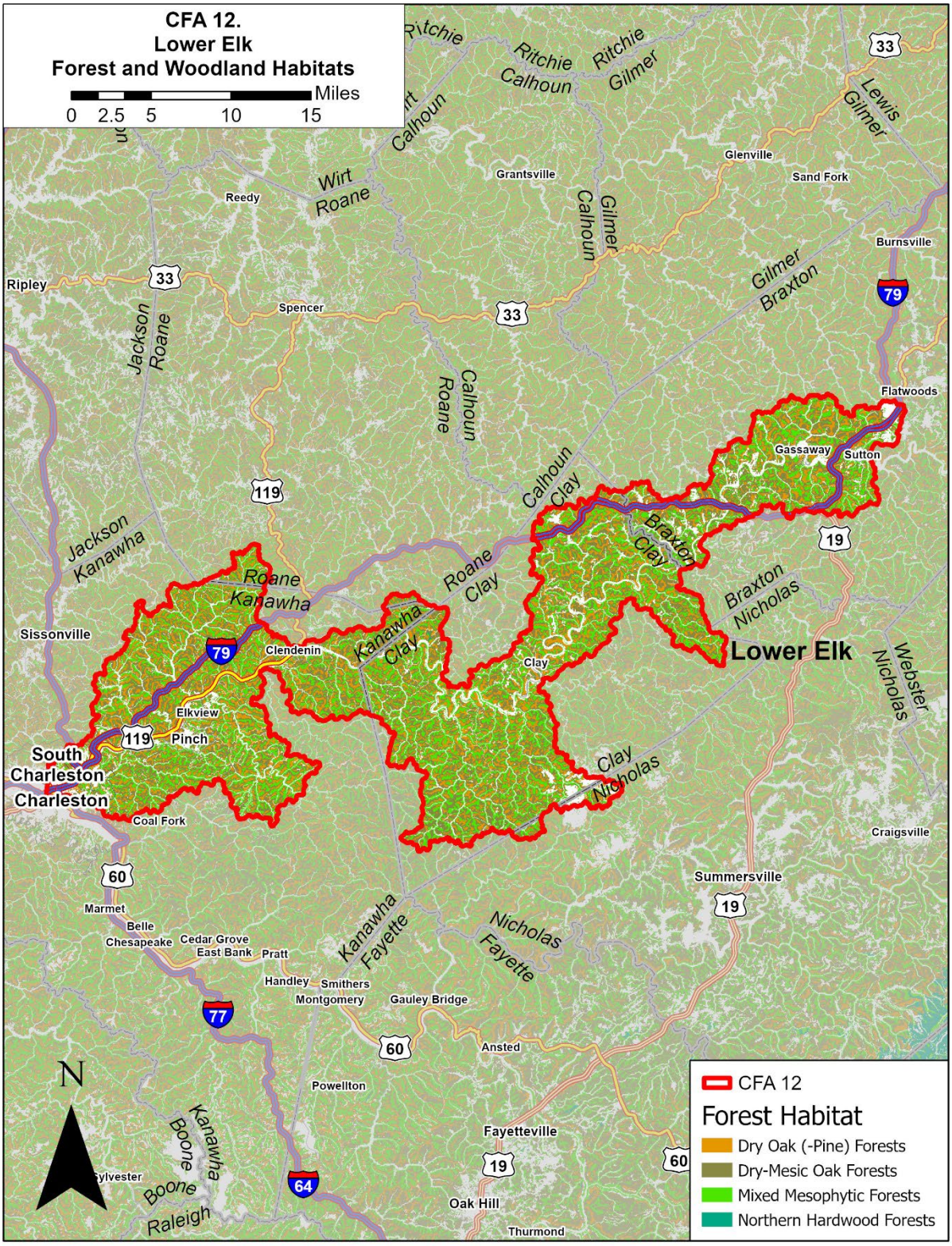
The Short Leaf Pine- Oak Forest is a rare plant community found in Forest and Woodland habitats in this CFA that is vulnerable to disturbance by logging. Disturbance should be avoided. Careful research on prescribed fire may illustrate potential benefits for restoring and maintaining these communities.

Table 6. Rare Plant Communities in Forest and Woodland Habitats.

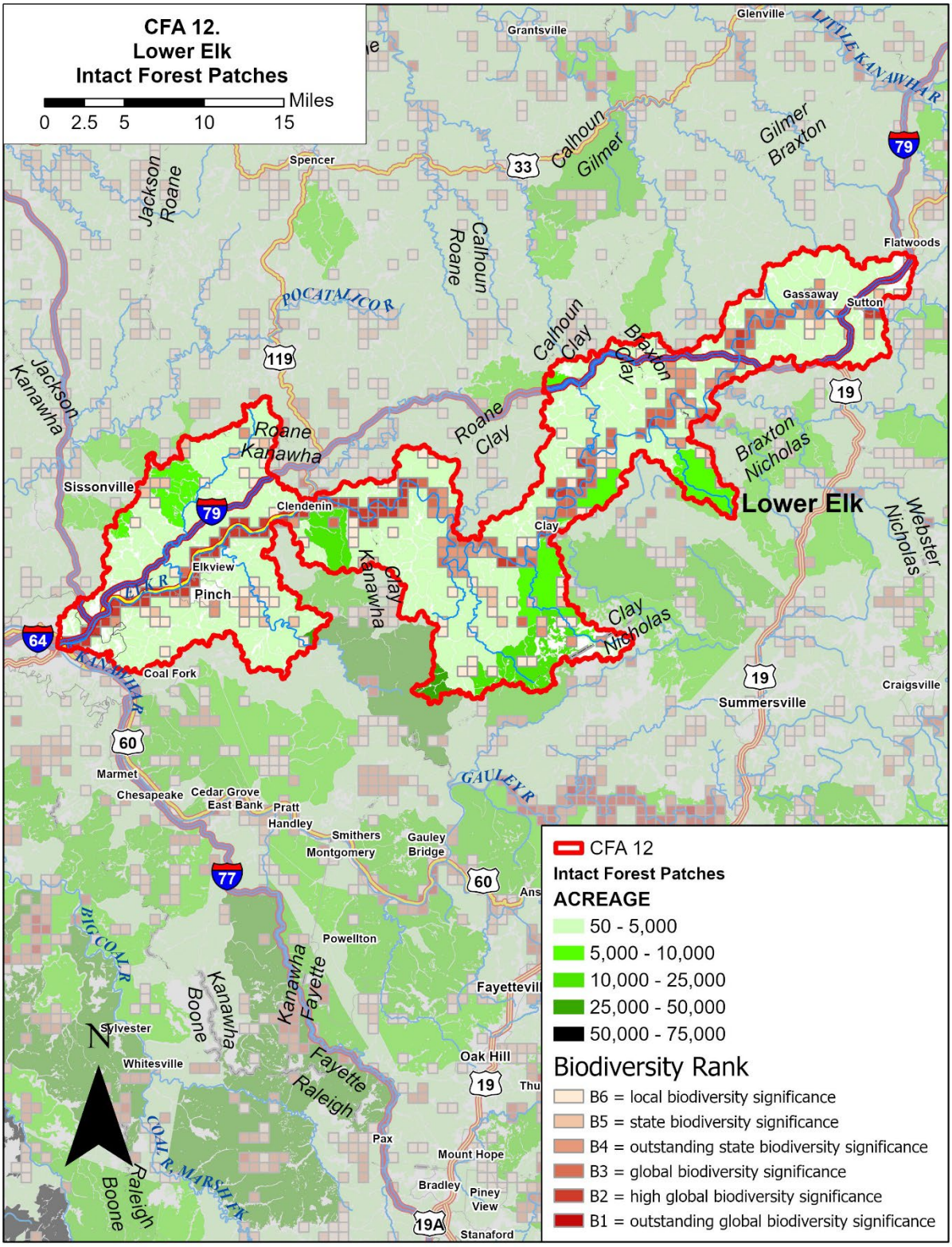
Common Name	Relative Abundance	G Rank	S Rank
Short Leaf Pine - Oak Forest	17%	G2	S2

S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.

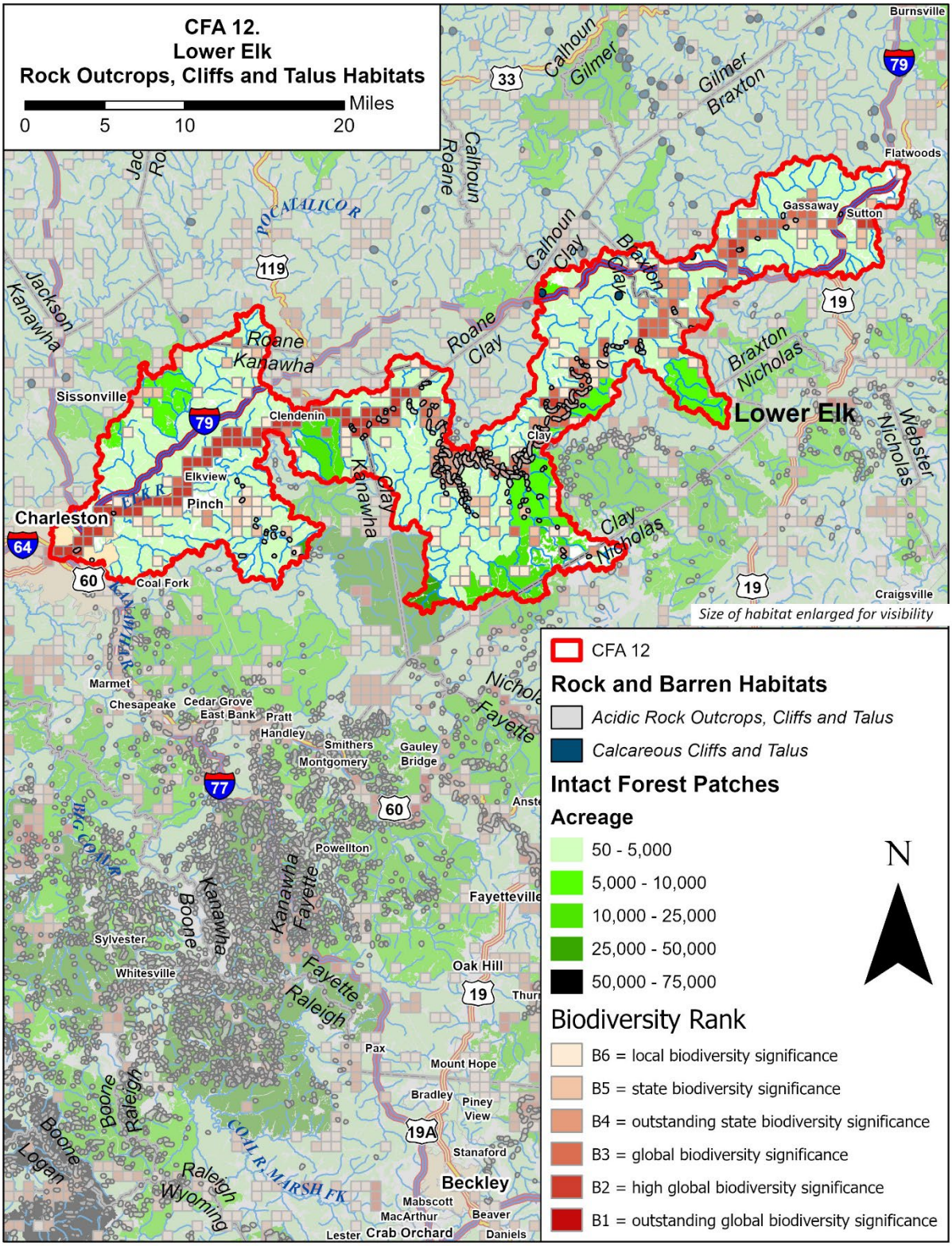
Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



Map 8. Rock Outcrop, Cliff & Talus Habitats



Habitat Stresses and Conservation Actions

Table 7 lists stresses impacting species in forest and woodland habitats and conservation actions landowners and partners can take to address those stresses.

Table 7. Stresses and Actions in Forest and Woodland Habitats:

Habitat Stress	**Conservation Action**
Deforestation, forest fragmentation, poor forest structure, climate change	Maintain and protect contiguous forest cover, structural and spatial complexity
Deforestation and disturbance of rare habitats and hydrological features	Maintain and protect forest cover and hydrology, especially around seeps, streams, rock outcrops, cliffs and talus and other rare habitat features
Nonnative invasive species: forest fragmentation, climate change	Maintain forest cover and control nonnative invasive species, especially around rare habitat features
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early successional habitat and structural complexity, including gaps with healthy native grasses, forbs, vegetative cover and snags
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity: old growth, small openings with well-developed understories, snags and decaying logs
Deer browse impacting forest structure	Manage local deer populations where abundant
Fragmentation of core forests from energy and other development	Develop state-level guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests
Incompatible utility corridor management	Improve vegetation management practices in utility corridors
Road collision/mortality (Eastern Whip-poor-will and Eastern Box Turtles)	Install highway signage in high density areas
Removal of woody vegetation in floodplain, riparian and agricultural areas	Restore and retain woody vegetation in floodplain, riparian and agricultural areas

In addition to the habitat-linked stresses listed above, direct stresses to priority species include the handling, spread of disease and illegal collection of Eastern Box Turtle, unknown status and need to survey rare plants such as the Blue Ridge Sedge and high mortality of Ruffed Grouse due to the West Nile Virus.

Maintaining a diverse population of forest birds requires dynamic forest landscapes with mosaics of age classes and structure. Efforts to manage and restore both early successional and interior forest habitat are needed for priority SGCN.

Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et al., 2015) described many potential impacts of climate change on forests in the region. Likely impacts include increased temperatures (especially during the summer and fall), a decrease in winter snowpack, longer growing seasons, increased precipitation during spring and even greater decreases in precipitation during summer and fall, more frequent heavy precipitation events and increasing frequency and severity of storms. These impacts will likely lead to changing soil moisture patterns, increased risk of wildfire, increased damage from pests and pathogens and increased extent and abundance of invasive plants. Habitat for northern species is likely to decline, although species such as red spruce may persist in cool, wet microclimates. Tree seedlings will likely be more vulnerable to climate change impacts than mature trees. Forest ecosystems lacking a diversity of species, age classes and genotypes may be at greater risk from climate change than those with greater diversity. Forest species in fragmented landscapes will have less opportunity to migrate across the landscape in response to changing conditions and ecological communities tied to specific hydrological conditions or geologic features may also be unable to migrate. Urban areas and impervious cover can exacerbate the effects of increasing temperatures and heavier precipitation. However, ecosystems within areas of high landscape complexity, including a diversity of topography and microhabitats, may be more able to persist and adapt in response to climate change.

The 2015 assessment also described likely impacts to specific forest types. Dry Mesic Oak Forests support of large number of tree species over a diversity of terrain and many of the tree species are tolerant of drought and fire, providing some resilience to climate change. However, drought may increase susceptibility to forest pests and pathogens, and drought, as well as disturbances from stronger storms, may enable the spread of nonnative invasive plants. Intense fires or droughts, combined with other stressors, could increase mortality of some species.

Dry Oak Pine Forests are adapted to heat, drought and fire, and may benefit from climate change. However, droughts may increase susceptibility to forest pests and pathogens, and enable nonnative invasive plants to outcompete native herbs and shrubs, providing additional fuel for fires and increasing fire intensity. Forest pests, pathogens and invasive plants need to be carefully managed to build resilience to climate change.

Mixed Mesophytic Forests may be vulnerable to increasing disturbance by wildfire, drought and invasion by nonnative plants. These ecosystems may decline in some areas, while sheltered sites in areas of complex topography may provide some refuge from climate change. Drought may increase the

susceptibility of these forests to hemlock woolly adelgid, forest tent caterpillar, beech bark disease and other insect pests and diseases. Invasive plants may outcompete native species as conditions change and drought may increase the risk of wildfire, to which these forests are not well adapted.

The small areas northern hardwood forests may be particularly impacted by climate change. Increased heat and moisture stress in summer and fall may interact with acid deposition as well as increases in insect pests and pathogens, storm disturbance and wildfires to stress these forests, reducing species diversity and coverage. Cool, moist sites within areas of complex topography may provide some refuge and buffer the effects of climate change.

Some changes in forest composition and structure are likely to occur over time as these different forest types adapt and adjust in response to changes in climate. Conservation actions to reduce existing stresses on forests will aid in building their resilience. Protection of large forest blocks in areas with complex topography and maintaining natural cover between them may further enable their adaptation and shifting distribution across the landscape.

Ecosystems that are limited by geological features, including rock outcrops, cliffs and talus habitats, may be restricted from shifting across the landscape in response to climate change. These habitat types are dependent on underlying geology, so their ability to shift across the landscape in response to climate change is very limited. While they are usually adapted to extreme conditions, they may be vulnerable to increased disturbance from drought, fire and storms, and from invasion by non-native invasive plants. Maintaining intact forest ecosystems around these rare habitats, and controlling invasive species, may help maintain resilience to a changing climate.

Table 8 provides a summary of climate stresses on forest habitats and actions which could boost their resilience (Swanston et al, 2016). While climate stresses are listed separately, forest and woodland habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions resemble previously listed conservation actions to reduce stress on priority species, meaning that they could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 8. Climate Stresses and Resilience Actions in Forest and Woodland Habitats

Climate Stresses	Habitat Resilience Actions
• Increased spring and summer temperatures • Increased risk of drought and wildfire • Increased frequency and severity of storms • Increased competition from nonnative invasive species, pests and pathogens	• Restore or maintain fire in fire-adapted ecosystems • Reduce deer herbivory to promote regeneration • Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species and remove existing invasive species • Promote diversity of native species and age classes through planting and silviculture • Protect habitat refugia for rare plant communities and forest types dependent on unique soils, such as rock outcrops, cliffs and talus • Protect forest reserves in areas of high biological diversity or priority species • Reduce forest fragmentation • Maintain or restore large patches and corridors of forest habitat • Restore native forest vegetation on degraded lands within and adjacent to forested areas

Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement and measure the effectiveness of conservation actions to benefit priority species in forest and woodland habitats.

Table 9. Implementation Plan for Forest and Woodland Habitats

Action	Partners	Effectiveness Measures
Forest Habitat, Reserve and Corridor Protection: • Conservation Easements • Land Acquisition • Natural Area designation	• County Farmland Protection Boards • The Nature Conservancy • WV Land Trust • WVDNR • WVDOF Forest Legacy	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Forest Habitat, Reserve and Corridor Protection: • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning in forested areas

Action	Partners	Effectiveness Measures
Forest Planning and Management • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs • USDA NRCS Climate Smart Forestry Activities	• AFF • AFTS, FSC, SFI • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WVDOF	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Manage forests at landscape scale for diversity of native species and age classes, structural and spatial complexity appropriate for the forest type	• AMJV • Consulting Foresters • Forest Certification Programs: AFTS, FSC, SFI • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Restore native forest vegetation on adjacent degraded lands through planting and silviculture	• Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species

Action	Partners	Effectiveness Measures
Create or maintain early-successional habitat (ESH) to benefit wildlife species through forest management on appropriate sites. GWWA guidelines for large forest patches with > 70% forest cover: • Maintain ESH on 15-20% of forest at any one time, as part of shifting mosaic ESH should include irregular, interspersed clumps of shrubs and/or saplings, grasses and forbs and widely spaced overstory trees (10-30% canopy cover or 20-40 ft2 residual basal area)	• Consulting Foresters • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites CERW guidelines for large forest patches with > 70% forest cover: Provide heterogenous stand structure and species diversity with 40-90 ft2 residual basal area of well-spaced, large diameter trees (favor white oak, hickory, sugar maple) with canopy gaps and well-developed understory vegetation. Mesic north- and east-facing slopes optimal.	• Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Monitor and control invasive weeds, promptly revegetate disturbed sites	• KCEMGA & KVMN • Public Land Managers • USDA NRCS • WVCA and GVCD • WVDOF • WVDOH	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Manage deer population where abundant	(hunting licenses) • Private landowners • Public Land Managers • WVDNR	• Change in deer population or forest structure • Acres of habitat restored • Before and after comparison: abundance and diversity of priority species
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	• Landowners, partners and utility companies	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Controlled burning by public agencies in fire adapted ecosystems	• Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Maintain forested buffers and minimize impact on fragile Rock Outcrop, Cliffs and Talus habitat	• Consulting Foresters • Public Land Managers • Quarries and developers	• Acres of habitat protected for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Planting and fencing stream buffer zones; Plant hedgerows and maintain woody vegetation in agricultural areas	• Trout Unlimited • USDA FSA • USDA NRCS • USFWS Partners for Fish and Wildlife • WVDEP and WVCA • WVDOF	• Acres or linear feet of stream buffer zones planted and fenced to protect priority species • Before and after comparison: abundance and diversity of priority species
Public & Landowner Outreach and Demonstration	• KCEMGA & KVMN • Public Land Managers • USDA NRCS • WVDEP, WVCA and Conservation Districts • WVDNR • WVDNR, WVDOF • WVU Extension	• # Landowners engaged • # Landowners implementing actions

Human Benefits

Actions to restore and protect forest and woodland habitat may provide human health and economic benefits for local residents and communities. These benefits include protection of water ways, water quality and drinking water sources, reduced flood damages, long-term timber production and opportunities for forest carbon sequestration, hunting, wildlife viewing, tourism and recreation.

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from warm, low-gradient headwater streams such as the Big Otter Creek, to warm, moderate gradient, large sized rivers such as Elk River. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are tightly connected with their adjacent floodplains, wetlands and riparian habitats. Many plant and animal species rely on aquatic habitats such as streams, rivers and wetlands, as well as their adjacent terrestrial habitats, especially riparian areas and forests. The loss of natural floodplain habitats and riparian corridors often impacts water quality and adjacent aquatic habitat. Improving wildlife habitat in streams and rivers often requires conservation actions to improve adjacent floodplain and riparian habitats. Therefore aquatic, floodplain, wetland and riparian habitats will be addressed together.

Priority Species

The following priority species occur in aquatic, floodplain and riparian habitats in the CFA.

Table 10. Priority Species in Aquatic Habitats

Taxa	Scientific Name	Common Name
Fish	Ammocrypta clara	Western Sand Darter
Fish	Ammocrypta pellucida	Eastern Sand Darter
Fish	Clinostomus elongatus	Redside Dace
Fish	Crystallaria cincotta	Diamond Darter
Fish	Etheostoma maculatum	Spotted Darter
Fish	Etheostoma tippecanoe	Tippecanoe Darter
Fish	Ichthyomyzon fossor	Northern Brook Lamprey
Fish	Lethenteron appendix	American Brook Lamprey
Fish	Notropis ariommus	Popeye Shiner
Fish	Noturus eleutherus	Mountain Madtom
Fish	Noturus stigmosus	Northern Madtom
Fish	Percina macrocephala	Longhead Darter
Fish	Polyodon spathula	Paddlefish
Mussels	Elliptio crassidens	Elephant-ear
Mussels	Epioblasma triquetra	Snuffbox
Mussels	Fusconaia subrotunda	Long-solid
Mussels	Lampsilis abrupta	Pink Mucket

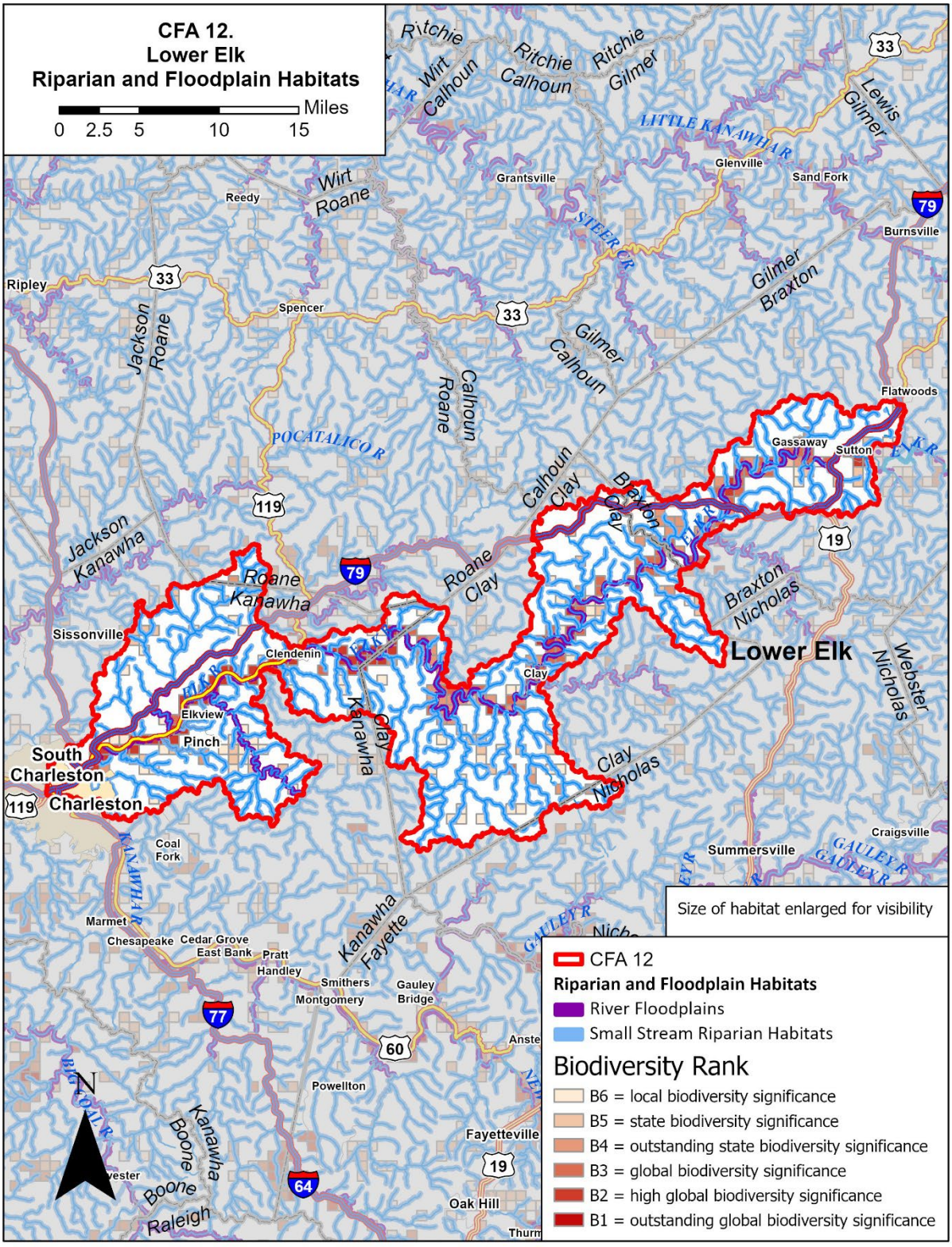
Taxa	Scientific Name	Common Name
Mussels	Paetuliunio fabalis	Rayed Bean
Mussels	Pleurobema clava	Clubshell
Mussels	Theliderma cylindrica	Rabbitsfoot

Table 11. Priority Species in Floodplains, Riparian and Wetland Habitats

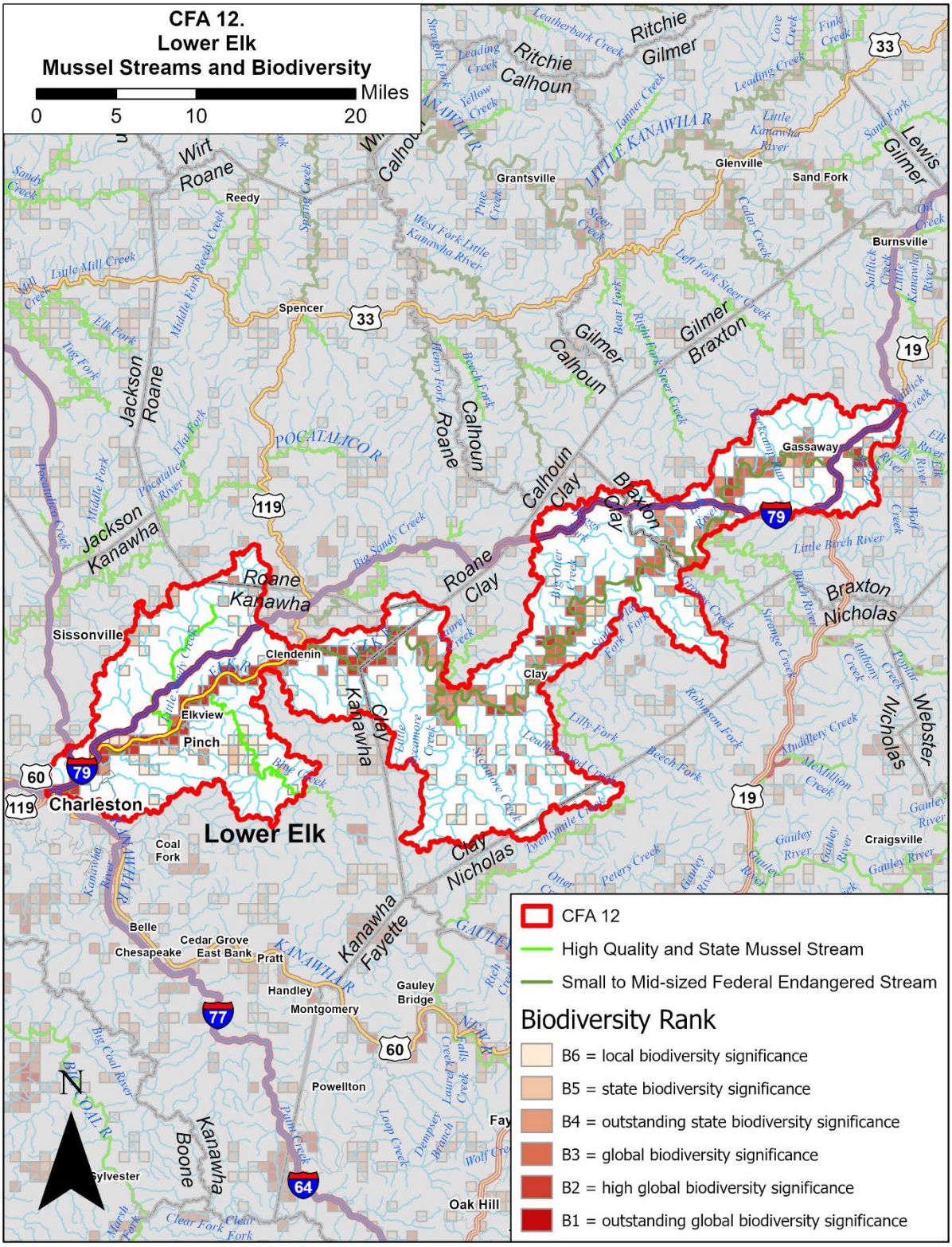
Taxa	Scientific Name	Common Name
Birds	Geothlypis formosa	Kentucky Warbler
Birds	Limnothlypis swainsonii	Swainson's Warbler
Birds	Megaceryle alcyon	Belted Kingfisher
Birds	Parkesia motacilla	Louisiana Waterthrush
Birds	Spizella pusilla	Field Sparrow
Butterflies and Moths	Euphydryas phaeton	Baltimore Checkerspot
Plants	Hypericum drummondii	Nits-and-lice
Plants	Lygodium palmatum	American Climbing Fern
Reptiles	Terrapene carolina carolina	Eastern Box Turtle

Map 9 illustrates riparian and floodplain habitats. Map 10 shows mussel streams (mapped by WVDNR in 2018) and biodiversity. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. River floodplain habitats occur along the Elk River and a few of its major tributaries, with small stream riparian habitats occurring along numerous smaller streams. The B-Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats, with dense concentrations along the Elk River. A large portion of the Elk River is designated as Small to Mid-Sized River for Federally Endangered Mussels, which include the Northern Riffleshell, Pink Mucket, Snuffbox, Rayed Bean and Clubshell mussels. Blue Creek, Little Sandy Creek and Sycamore Creek are designated High Quality and State Mussel Streams. Aquatic and riparian habitats outside of larger forest patches may be more vulnerable to stresses.

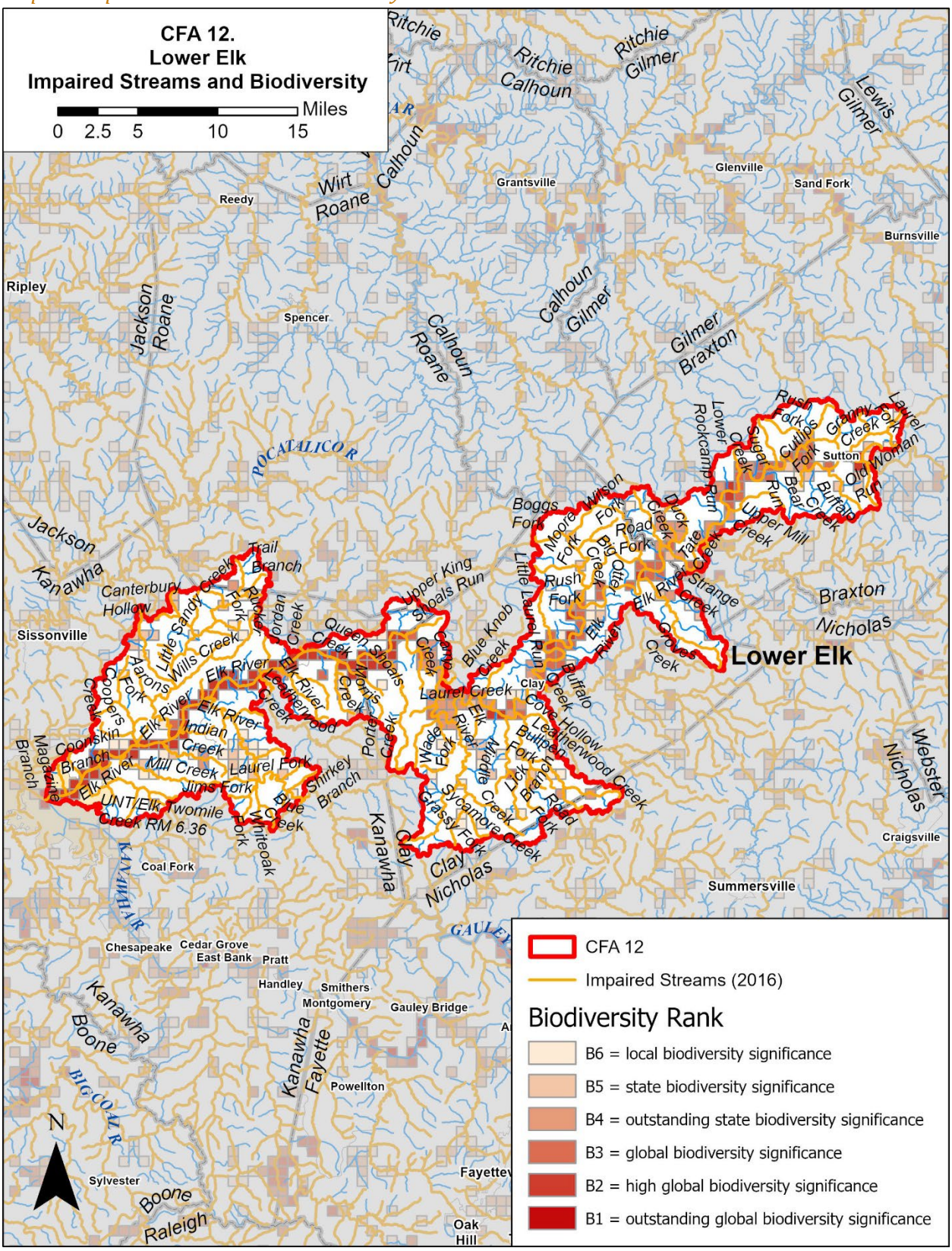
Map 9. Riparian and Floodplain Habitats



Map 10. Mussel Streams and Biodiversity



Map 11. Impaired Streams and Biodiversity



Habitat Stresses and Conservation Actions

Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly and plant species. Direct stresses to priority species include the illegal collection of Eastern Box Turtles, stream passage barriers limiting the movement of Northern Brook and American Brook Lampreys and loss of host fish impacting the development of juvenile Elephant-ear and Snuffbox mussels.

Map 11 shows stream impairments, along with biodiversity. The most heavily impaired streams include Buffalo Creek, Elk River, Leatherwood Creek, the left fork of Morris Creek, Road Fork, Slack Branch and Whiteoak Fork (WVDEP, 2014). These streams suffer from at least four known forms of impairment, the most common being fecal/bio and iron (WVDEP, 2014). Many of these same impaired streams host clusters of biodiversity and provide habitat for mussels and other priority species. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present. A table providing a list of all impaired streams and their causes present within the CFA can be found in Appendix 4.

Table 12. Habitat Stresses & Conservation Actions in Aquatic, Floodplain & Riparian Habitat

Habitat Stress	**Conservation Action**
Lack of protected floodplain, shoal, island, sandbar, wetland and riparian habitat	Habitat protection through land use planning, conservation easements, acquisition and other programs and activities
Point and nonpoint-source pollution in waterways causing water quality impairment and algae blooms	Identify and mitigate causes of sedimentation and pollution, improve sewage treatment, storm water management, sediment and nutrient load reductions, acid mine drainage treatment, implement mining and logging BMPs and plant and protect riparian buffers
Potential for hazardous spills into aquatic ecosystems	Develop hazard spill prevention and response protocol to protect aquatic ecosystems and priority species
Riparian habitat disturbance and deforestation, road crossings, altered hydrology, increased runoff and stream temperatures, climate change	Landowner outreach; Plant, fence, maintain forested riparian corridors, including in agricultural areas; Minimize disturbance

Habitat Stress	Conservation Action
River channelization, stream bank erosion, disconnection of river and floodplain hydrology and habitats	Restore and protect floodplain, riparian, stream bank, channel, island, shoal and sandbar habitats and functions
Cool water releases from Sutton Dam impact mussel reproduction	Coordinate with Sutton Dam to manage releases
Disturbance of mussel beds	Protect and avoid disturbance to mussel beds. Survey and salvage mussels before disturbance activities.
Loss of host-fish interaction (mussels)	Manage host fish species, explore inoculation of host fish
Nonnative invasive plants	Monitor and carefully treat nonnative invasive plants
Deer herbivory on host plants (butterflies and moths)	Identify and reduce deer populations near host plant populations
Deforestation, disturbance, water withdrawals and runoff from oil/gas development	Increased coordination with WVDNR, maintain forested riparian corridors, minimize disturbance and water withdrawals, control invasive plants and runoff, implement Unconventional Oil & Gas BMPs and sediment controls
In-stream habitat impacts (mussels)	Consider habitat needs in construction plans; survey and salvage before construction activities
Aquatic passage barriers	Modify or remove barriers
Degradation of wetlands	Maintain wetland integrity and buffers

Climate Change and Habitat Resilience

As noted in the Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et al., 2015), riparian forests are vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation. Impervious cover may exacerbate these impacts. Drought may stress plants and increase their susceptibility to forest pests and pathogens. Warming temperatures and increased disturbances may enable nonnative invasive plant species to outcompete native species. Although riparian forests are adapted to some level of disturbance and variable

conditions, habitat alterations and invasive species may limit the ability of riparian forests to adapt to climate change. Restoring and maintaining the health, acreage and connectivity of native riparian forests along streams and rivers will build their resilience to climate change.

The Assessment also describes how instream habitats and associated plant and animal species may be stressed by climate change-related increases in temperature, droughts, flood frequency and severity, and resulting erosion and sedimentation. Low flow events may also become more frequent and severe. Warming surface waters is likely to result in water quality degradation and eutrophication. Many aquatic species and life stages are adapted to specific timing and ranges of flow and temperature, as well as water quality variables. Climate change may impact different species and life stages in different ways. Cold water habitats and aquatic communities may be at particular risk. Areas within a watershed may be more or less sensitive to increases in air temperature, depending on local factors such as watershed characteristics, position within the watershed, upstream land uses, groundwater contributions, forest cover and shading.

Restoring and maintaining the health, size and connectivity of native riparian forests along streams and rivers can provide riparian habitat, shade and cooling, organic matter, structure and debris, protect stream banks and in-stream habitat during high flows and maintain water quality. Stabilizing eroding stream banks using natural channel design techniques and reconnecting streams with their floodplains can restore fluvial processes and floodplain habitats. Cleaning and enlarging culverts and stream crossings to accommodate increased peak flows and aquatic organism passage can reduce flood damage to infrastructure and habitat and allow aquatic organisms to reach additional habitat as they adapt to changing conditions.

Table 13 provides a summary of climate stresses on aquatic, floodplain and riparian habitat, and actions to boost their resilience (Swanston et al., 2016). While climate stresses are listed separately, aquatic, floodplain and riparian habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions reiterate previously listed conservation actions to reduce stress on priority species and could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 13. Climate Stresses & Resilience Actions in Aquatic, Floodplain & Riparian Habitat

Climate Stresses	Habitat Resilience Actions
• Increased flood frequency and severity, erosion and sedimentation • Increased surface water temperatures, low-flow events and water quality degradation • Increased risk of drought and wildfire • Increased competition from nonnative invasive species, pests and pathogens	• Restore and maintain the health, diversity and connectivity of riparian forests • Stabilize eroding streambanks and reconnect stream hydrology to floodplains • Clean and enlarge culverts and stream crossings to accommodate peak flows and aquatic organism passage • Minimize disturbance to riparian forests, promptly revegetate after disturbance, prevent the introduction and establishment of invasive plant species and remove existing invasive species • Protect refugia for cold water habitat

Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement and measure the effectiveness of conservation actions to benefit priority species in aquatic, floodplain and riparian habitats.

Table 14. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition • Natural Area designation on Public Lands	• County Farmland Protection Boards • The Nature Conservancy • USDA NRCS • WV Land Trust • WVDNR & Public Land Managers	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Cost Share and Incentive Programs	• USDA FSA	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Land Use Planning • Floodplain Management • Hazardous Spill and Prevention Planning	• County Planning Commissions/Departments • Local governments • WVDEP • WVDNR • WVDOH	• Acres or miles of habitat protected through planning, floodplain and stormwater regulations
In-stream and riparian habitat restoration (including floodplain reconnection, island, shoal and sandbar habitats)	• Public Land Managers • Trout Unlimited • USACE • USDA FSA & NRCS • USFWS	• Acres or linear feet of in-stream and riparian habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Planting and fencing stream buffer zones, landowner outreach	• Trout Unlimited • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife • WVDEP and WVCA • WVDOF	• Acres or linear feet of stream buffer zones planted and fenced to protect priority species • Before and after comparison: abundance and diversity of priority species
Manage host fish species, explore inoculation of host fish	• USFWS • WVDNR	• Before and after comparison: abundance and diversity of priority species
Avoid disturbance of mussel beds, consider habitat needs in construction plans, survey and salvage before construction activities	• USACE • USFWS • WVDEP • WVDNR	• Before and after comparison: abundance and diversity of priority species
Identify host plant populations (butterflies & moths) and reduce nearby deer populations	• Public Land Managers • WVDNR	• Before and after comparison: abundance and diversity of priority species
Remove or improve aquatic passage barriers	• Public Land Managers • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOH • WVRC	• # barriers improved or removed • # miles stream opened • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Minimize riparian and in-stream disturbance and water withdrawals, control invasive plants and runoff, implement Unconventional Oil & Gas BMPs and sediment controls	• Oil and Gas companies • WVDEP • WVDNR	• Before and after comparison: abundance and diversity of priority species
Identify and mitigate causes of sedimentation and pollution: improved sewage treatment, storm water management, sediment load reductions, implement mining and logging BMPs, plant and protect riparian buffers	• Local governments • WVDEP • WVDHHR • WVDNR • WVDOF • WVDOH	• # wastewater and stormwater systems installed or improved • Change in fecal, sediment and other water quality measurements • Before and after comparison: abundance & distribution of priority species
Improve water quality in streams and wetlands	• USDA FSA • USDA NRCS • WVDEP and WVCA	• Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Monitor and carefully treat nonnative invasive plants around streams and wetlands	• KCEMGA & KVMN • USDA FSA • USDA NRCS • USFWS • WVDOH	• Acres treated • Treatment success rate • Before and after comparison: abundance and diversity of priority species
Public & Landowner Outreach and Demonstration	• KCEMGA & KVMN • Local communities and organizations • Public Land Managers • USDA NRCS • USFWS • WV Rivers Coalition • WVCA and Conservation Districts • WVDEP, WVDNR, WVDOF • WVU Extension	• # of people involved in outreach activities • # of people involved in restoration and protection activities

Human Benefits

Actions to restore and protect aquatic, floodplain and riparian habitat may have numerous health and economic benefits for local residents and communities, including absorption and reduction of pollution in water ways and drinking water sources, absorption and reduction of flood waters and reduced flood damages, soil conservation and improved agricultural productivity and improved hunting, fishing and recreational opportunities.

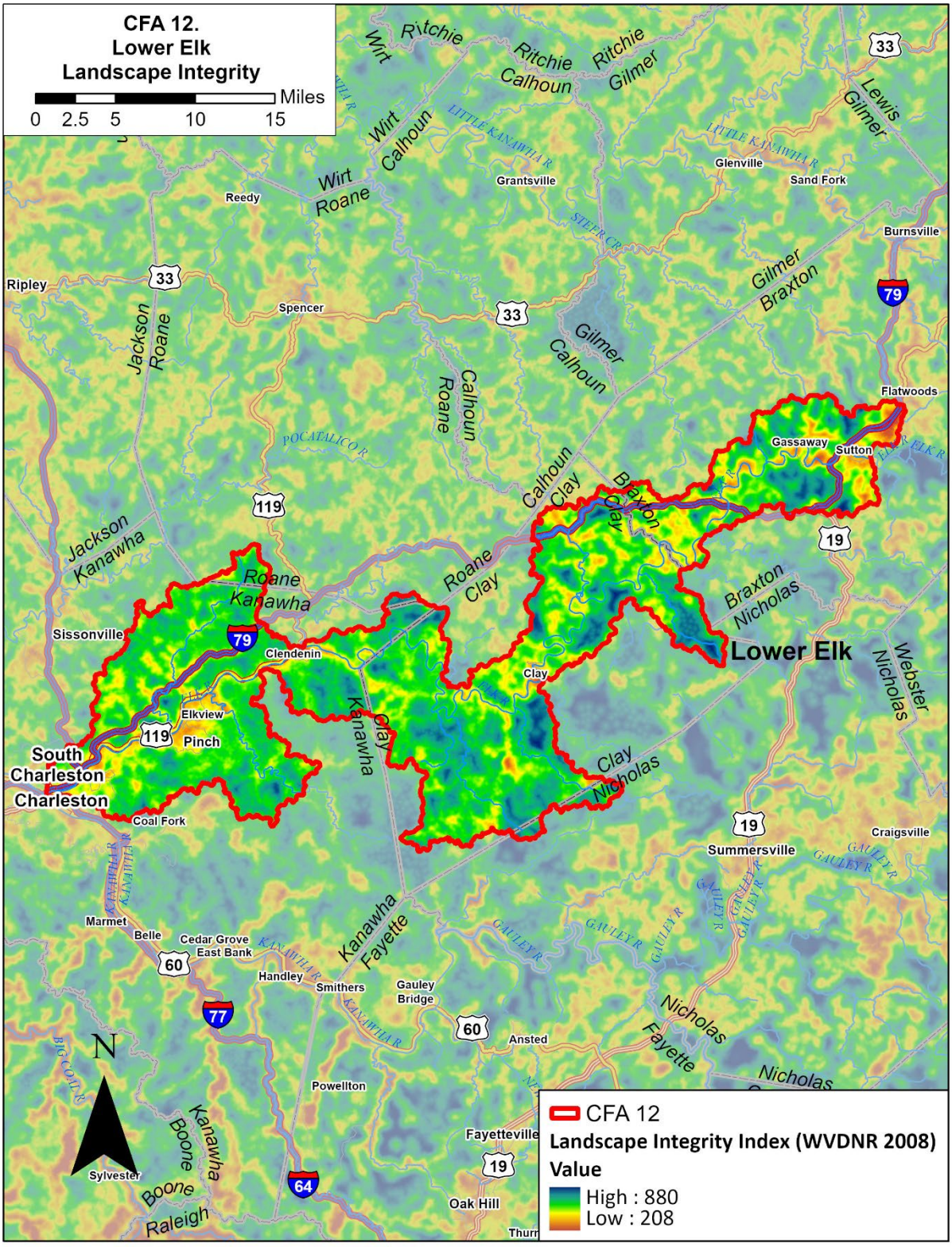
Landscape Resilience and Connectivity

The conservation and resilience actions described previously in this plan aim to reduce stressors on priority species in each major habitat type and enhance the resilience of those habitats to climate change. Some of those actions include protecting refugia, core areas of intact habitats and habitat corridors. Habitat cores are patches of high-quality habitat for priority species, surrounded by areas with a different community structure and serve as nodes in a connected ecological network (Harrison and Odell, 2016; USDA Natural Resources Conservation Service, 2004). Habitat cores identified for protection in this CFA include large forest blocks, wetlands, habitats limited to specific soil types and geology such as shale barrens, cliffs and talus, biologically significant caves and their buffer zones and core aquatic habitat such as mussel streams. Important habitat corridors identified for protection include connected forest patches, intact river floodplains and small stream riparian forests. Protecting corridors of terrestrial and aquatic habitat connected to habitat patches and larger core areas may allow for species movement and enhance the flow of genetic material in response to climate change (Butler et al., 2015; Anderson et al., 2016a).

Maintaining or restoring wildlife populations in a changing climate may require conservation actions at a landscape level, across habitat types and beyond individual habitat cores and corridors. Anderson (2016b) summarized a wealth of current research demonstrating how the increasing frequency and severity of storms, floods, droughts and fires may cause species to respond by shifting location or behavior within their existing habitat, evolving to adapt to new conditions, or shifting their distributions across the landscape. Evidence has been documented for over 1,000 species currently shifting one of four ways: locally toward suitable microclimate, upslope to higher elevations, downslope towards moist riparian areas and northward toward cooler latitudes. However, landscape fragmentation has been shown to slow movement in response to climate change. Enabling wildlife to shift and adapt to climate change will require the conservation of a network of unfragmented landscapes within which species can shift their range to more suitable local microclimates or upslope, downslope or northward.

In 2008 the WVDNR developed a model of landscape integrity to identify unfragmented landscapes. Map 12 illustrates areas of high landscape integrity in the CFA. Landscape integrity is estimated to increase with distance from roads, powerlines, development and other features that fragment the landscape. These high integrity landscapes tend to correspond to larger forest patches. There are also landscapes of high integrity in private ownership adjacent to public lands. These areas are important for species movement in response to climate change and are priorities for protection of wildlife habitat.

Map 12. Landscape Integrity



Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic diversity that offer a range of habitat types and microclimates for species and ecosystems to adapt to climate change. Resilient sites also have high landscape integrity, enabling species to move locally in response to climate change and natural processes like fire and floods to continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the regional flow of species across the landscape over time in response to climate change, as constrained by natural and human-caused barriers. This led to the identification of corridors of constrained movement and flow zones of dispersed movement. These are corridors and core areas for species movement and adaptation at a landscape level.

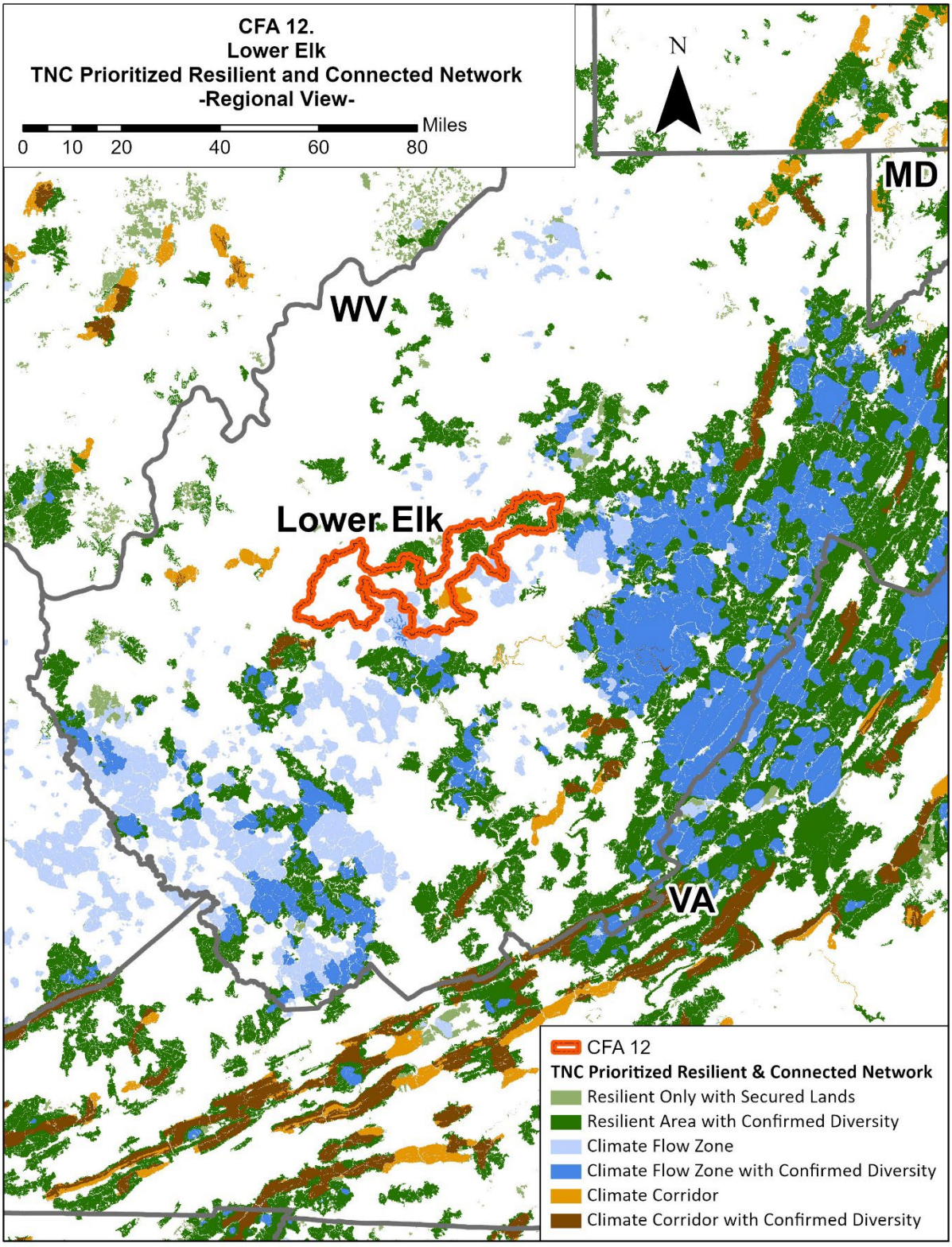
Next, the team developed models that integrated landscape resilience, connectivity and the flow of species across the landscape. They selected a connected network of sites that represents the full suite of geophysical settings, includes known records of biological diversity and has the configuration and connections necessary to support the continued movement of species in response to change conditions. Within this network they identified the places most essential for sustaining biodiversity in a changing climate and are also aligned to the natural flow patterns across the region. This included the most resilient and diverse lands representing all of the region's geophysical settings, recorded occurrences of biological diversity, resilient lands already secured through public ownership or conservation easements and the riparian corridors and other landscape linkages with the most concentrated movement of species. This prioritized network covers 23% of the land in the Eastern United States.

This work is documented in Resilient Sites for Terrestrial Conservation in Eastern North America (Anderson et al, 2016a) and Resilient and Connected Landscapes for Terrestrial Conservation (Anderson et al, 2016b). The studies produced a series of maps (see http://maps.tnc.org/resilientland/) that identified the following areas:

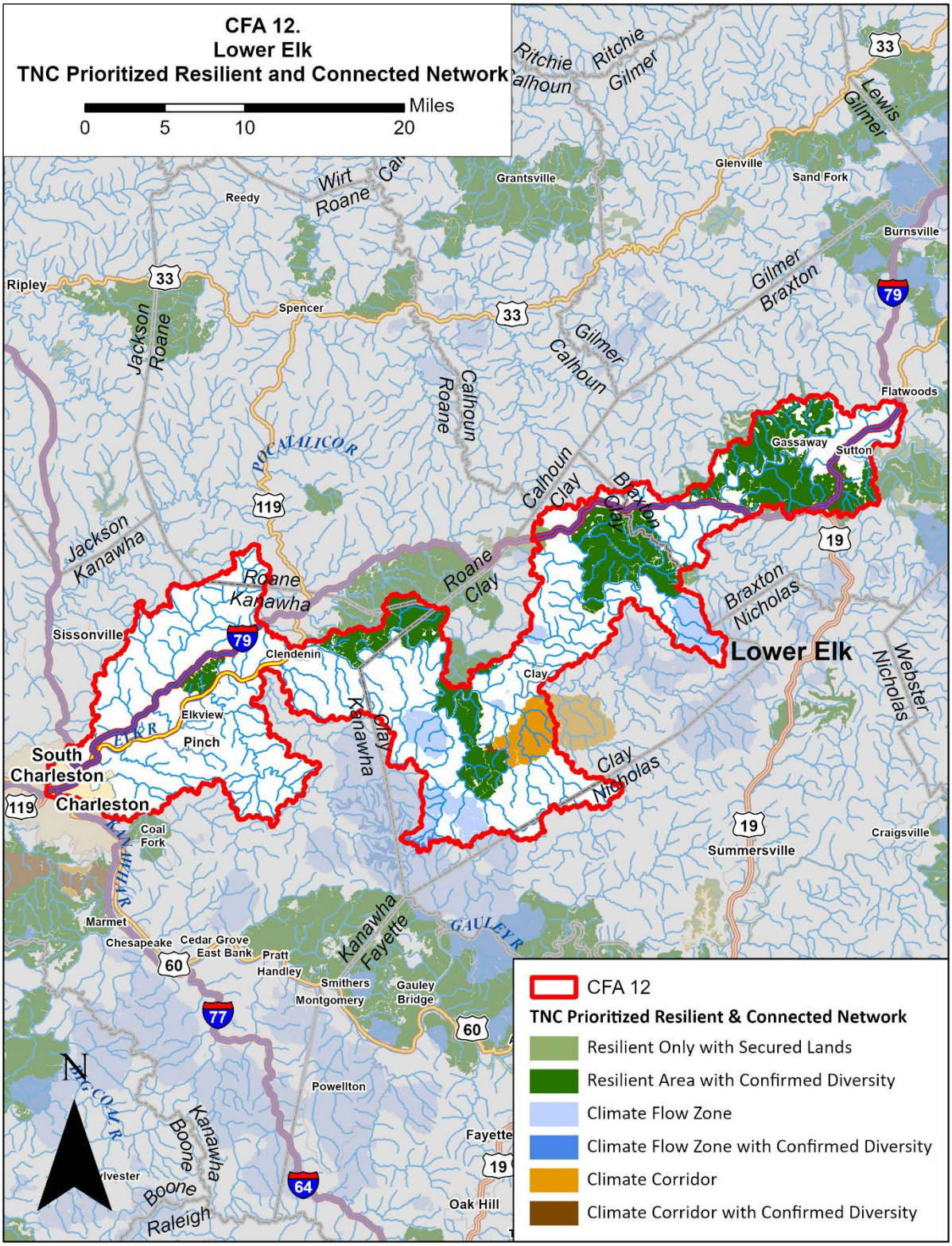
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes concentrated, often along a stream corridor or ridgeline
- Climate flow zone: areas with high levels of plant and animal movement that is less concentrated than in a corridor, such as an intact forest patches and areas of high integrity

Map 13 provides a regional view of priority resilient and connected landscapes. This map illustrates that the patches of resilient lands and climate corridors within the CFA connect to the larger cluster of resilient landscapes and flow zones in eastern West Virginia, which link to narrow climate corridors both north into Maryland and Pennsylvania and south into Virginia. The resilient, connected landscapes in this CFA are critical to the species adapting to climate change within the larger network across the Eastern United States.

Map 13. Priority Resilient and Connected Network – Regional View



Map 14. Priority Resilient and Connected Network – Detailed View



Map 14 provides a detailed view of the resilient, connected landscapes in the Lower Elk River CFA. The eastern half of the CFA is mostly bare of resilient and connected lands, as you progress east and move away from Charleston resilient areas, climate flow zones and climate corridors begin to appear more frequently and in larger blocks. These priority resilient and connected landscapes contain the CFA's high integrity areas and portions of the CFA's rock outcrop, cliff and talus and known biodiversity.

Protecting and maintaining these areas of high landscape integrity and the resilient areas, climate corridors, and climate flow zones within the region's priority resilient and connected network is critical in order to enable priority SGCN and their habitat to adapt to climate change and persist in this CFA. These areas are priorities for conservation action within the CFA.

Table 15 summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Table 15. Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	Conservation Action
• Changing conditions exacerbating existing stresses on species and habitat • Species responding to climate change by shifting locally as well as across the landscape • Landscape fragmentation that prevents or constrains species movement	• Protect and maintain a connected network of resilient landscapes, flow zones and climate corridors across the landscape for species to adapt and shift locally and regionally in response to climate change

Implementation Plan

The resilient and connected landscapes in this CFA provide critical links to the larger network of resilient and connected landscapes in West Virginia, Maryland, Virginia, the Central Appalachians, and Eastern North America. They provide a blueprint of habitat cores and corridors where conservation actions to restore, maintain and protect natural habitat and remove barriers to movement will be crucial to enabling priority species and habitats to shift and adapt to climate change at both local and regional scales. Table 16 lists specific actions to protect, maintain and restore the network of resilient, connected lands within the CFA.

Table 16. Implementation Plan for Landscape Resilience and Connectivity

Action	**Partners**	**Effectiveness Measures**
Protection of Resilient, Connected Landscapes • Conservation Easements • Land Acquisition	• County Farmland Protection Boards • The Nature Conservancy • USDA NRCS • WV Land Trust • WVDNR	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Protection of Resilient, Connected Landscapes • Land use planning • Floodplain Management	• Local Government and Planning Commissions	• Acres of habitat protected through land use planning in resilient, connected landscapes
Forest Planning and Management • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs • USDA NRCS Climate Smart Forestry Activities	• AFF • AFTS, FSC, SFI • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WVDOF	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Protection of Resilient, Connected Landscapes • Conservation and Management	• Partner Organizations • Private Landowners • US Forest Service • WVDNR	• Acres of habitat protected, restored, and maintained in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats

Conclusion

Habitat Conservation Priorities

This action plan lists priority species and rare plant communities targeted for conservation action on public and private land and within each major habitat type. The major habitat types include forests and woodlands, aquatic, riparian and floodplain habitats. For each major habitat type the plan identifies stresses that affect priority species, conservation actions to reduce those stresses, climate stresses on those habitats, actions to boost resilience, partners that can assist with conservation actions to implement the plan, and the human benefits of conservation.

Below is a list of the priority habitats identified by this Action Plan for conservation action within each major habitat type.

- Large, intact forest patches, including interior forest habitat
- Early successional forest habitat and woody vegetation in floodplains and agricultural areas
- Small areas of unique, geologically derived habitat embedded in the forested landscape, including:
    - Acidic rock outcrops, cliffs and talus
    - Calcareous cliffs and talus
- Special aquatic habitats, such as mussel streams
- Small stream riparian and river floodplain habitats

These priority habitats include habitat cores and corridors that are critical for maintaining wildlife populations in this CFA. To protect priority SGCN and enable them to adapt to changing conditions within these priority habitats, landowners and partner organizations are encouraged to plan and implement conservation actions to alleviate stresses on priority species and boost habitat resilience, and carefully monitor the results using an adaptive management framework such as the Climate Smart Conservation Cycle included in the introduction. Stakeholders are also encouraged to coordinate with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to these priority habitats.

Integration of Conservation Actions

Integration of conservation actions within the above priority habitats, such as projects to improve mussel stream habitat by improving wastewater treatment, enlarging stream crossings and planting riparian stream buffers may benefit multiple plant communities and wildlife species. Coordinating actions across multiple habitats, such as protecting large patches of diverse forest habitats that also include rare rock outcrops or cliff and talus habitats, may benefit additional species. Private landowners, public land managers and conservation partners are encouraged to focus resources across priority habitats to maximize benefits to multiple species.

Connecting Conservation Actions for Climate Resilience

As we have seen, conservation actions to relieve stresses on priority species and efforts to boost the resilience of wildlife habitat are essential for enabling climate adaptation. Maintaining and protecting

areas of high landscape integrity as well as the regional network of resilient lands, climate corridors, and flow zones is also critical for enabling wildlife species to adapt to changing conditions and shift across the landscape.

Furthermore, creating local networks of connected habitat cores and corridors will enhance their resilience and connectivity, and the ability of wildlife species to adapt to changing conditions within this CFA. Connected local networks of headwater streams and larger rivers, their riparian corridors, floodplains and wetlands enhances the stability of these habitats and enables fish, reptiles, birds and other priority wildlife species that depend on those habitats to move across the landscape as conditions change. Maintaining connections between patches of diverse forest habitat and with rare rock outcrops, cliffs and talus habitats enhances the resilience of these habitats and enables forest species to move to optimal sites as conditions change. Conservation of aquatic, riparian and floodplain corridors along with areas of native vegetation in and around agricultural areas, small forest patches and larger blocks of forest habitat can create a local network of resilient, connected lands that merges into the larger regional network. Beyond undertaking conservation actions in the priority habitats listed above and protecting the regional network of climate connectors and flow zones, stakeholders are encouraged to restore and protect the connections between these areas in order to maintain an interwoven fabric of natural systems for wildlife within this CFA to thrive long into the future.

Next Steps in Implementation

WVDNR engaged a working group of partner organizations and public land managers in developing this Action Plan and will seek to remain engaged by convening semi-annual meetings with the working group to collaborate on actions including the following:

- Planning, implementing and evaluating ongoing field surveys of priority species to document and monitor their abundance, distribution, population trends, vulnerability and range shifts
- Planning, implementing, monitoring and evaluating the results of the conservation actions
- Engaging and supporting private landowners in this work.

WVDNR may lead some of these efforts but will most often play the role of supporting efforts by the many partners active in this CFA with ongoing projects, established programs and connections with landowners. In the case of public lands, WVDNR will also seek to incorporate conservation actions targeting priority species, habitats and priority areas for conservation action into agency planning processes and support those actions. WVDNR will also work with state agencies and other authorities to promote avoidance, minimization and mitigation for development impacts to priority habitats and other priority areas for conservation action.

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Appendix 1. SGCN in the Greater Greenbrier CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Amphibians	Acris crepitans	Northern Cricket Frog	S2	G5	—	
Amphibians	Aneides aeneus	Green Salamander	S3	G3G4	—	
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3G4	—	
Amphibians	Gyrinophilus porphyriticus duryi	Kentucky Spring Salamander	S3	G5T4T5		
Amphibians	Pseudotriton ruber ruber	(northern) Red Salamander	S3	G5		
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5		
Birds	Bonasa umbellus	Ruffed Grouse	S3B,S3N	G5	R	
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5		
Birds	Butorides virescens	Green Heron	S3B	G5		
Birds	Chaetura pelagica	Chimney Swift	S3B	G5	—	
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5	—	
Birds	Colinus virginianus	Northern Bobwhite	S1B, S1N	G5	—	
Birds	Falco sparverius	American Kestrel	S3B	G5	—	
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5	R	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5		
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5	R	
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5	R	At Risk-Cons
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5		
Birds	Limnothlypis swainsonii	Swainson's Warbler	S3B	G4	—	
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5		
Birds	Petrochelidon pyrrhonota	Cliff Swallow	S3B	G5		
Birds	Piranga rubra	Summer Tanager	S3B	G5	—	
Birds	Scolopax minor	American Woodcock	S3B	G5	R	
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4	—	At Risk - Cons
Birds	Spizella pusilla	Field Sparrow	S3B, S3N	G5	R	
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5	R	
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5		
Butterflies & Moths	Celastrina neglectamajor	Appalachian Azure	SNR	G4		
Butterflies & Moths	Euphydryas phaeton	Baltimore Checkerspot	S3S4	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Butterflies & Moths	Speyeria diana	Diana Fritillary	S2S3	G3G4		At Risk-Science
Crayfish	Cambarus elkensis	Elk River Crayfish	S1	G2		
Dragonflies & Damselflies	Hylogomphus viridifrons	Green-faced Clubtail	S3	G3G4		
Dragonflies & Damselflies	Phanogomphus descriptus	Harpoon Clubtail	S2S3	G4		
Dragonflies & Damselflies	Phanogomphus quadricolor	Rapids Clubtail	S3	G3G4		
Dragonflies & Damselflies	Ladona deplanata	Blue Corporal	S3	G5		
Dragonflies & Damselflies	Macromia illinoiensis	Illinois River Cruiser	S3	G5		
Dragonflies & Damselflies	Macromia taeniolata	Royal River Cruiser	S3	G5		
Dragonflies & Damselflies	Progomphus obscurus	Common Sanddragon	S2S3	G5		
Fish	Ammocrypta clara	Western Sand Darter	S1	G3		
Fish	Ammocrypta pellucida	Eastern Sand Darter	S3	G3	—	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Fish	Carpiodes carpio	River Carpsucker	S3	G5		
Fish	Chrosomus erythrogaster	Southern Redbelly Dace	S2S3	G5		
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4		
Fish	Crystallaria cincotta	Diamond Darter	S1	G1	E	
Fish	Etheostoma maculatum	Spotted Darter	S1	G2	—	
Fish	Etheostoma tippecanoe	Tippecanoe Darter	S2	G3G4	—	
Fish	Ichthyomyzon bdellium	Ohio Lamprey	S2S3	G3G4	—	
Fish	Ichthyomyzon fossor	Northern Brook Lamprey	S1	G4	—	
Fish	Ichthyomyzon unicuspis	Silver Lamprey	S2S3	G5		
Fish	Ictiobus cyprinellus	Bigmouth Buffalo	S1	G5		
Fish	Ictiobus niger	Black Buffalo	S2	G5		
Fish	Lethenteron appendix	American Brook Lamprey	S2	G4		
Fish	Macrhybopsis hyostoma	Shoal Chub	S2	G5		
Fish	Macrhybopsis storeriana	Silver Chub	S3	G5		
Fish	Moxostoma carinatum	River Redhorse	S3	G4		
Fish	Notropis ariommus	Popeye Shiner	S2	G3		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Fish	Noturus eleutherus	Mountain Madtom	S2	G4		
Fish	Noturus stigmosus	Northern Madtom	S1	G3		
Fish	Percina copelandi	Channel Darter	S2S3	G4		
Fish	Percina evides	Gilt Darter	S2	G4		
Fish	Percina macrocephala	Longhead Darter	S2	G3	—	
Fish	Percina sciera	Dusky Darter	S3	G5		
Fish	Polyodon spathula	Paddlefish	S1	G4		
Mammals	Corynorhinus rafinesquii	Eastern Big-eared Bat	S1	G3G4		
Mammals	Lasiurus borealis	Eastern Red Bat	S4	G5	R	
Mammals	Lasiurus cinereus	Hoary Bat	S3	G5	—	
Mammals	Myotis lucifugus	Little Brown Myotis	S2*	G3	R	
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2G3	T	
Mammals	Neotoma magister	Allegheny Woodrat	S3	G3G4	—	
Mammals	Perimyotis subflavus	Tricolored Bat	S2*	G3	R	
Mussels	Actinonaias ligamentina	Mucket	S3	G5		
Mussels	Alasmidonta marginata	Elktoe	S1	G4	—	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Mussels	Amblema plicata	Threeridge	S3	G5		
Mussels	Anodontoides ferussacianus	Cylindrical Papershell	S2	G5		
Mussels	Cambarunio iris	Rainbow	S2	G5Q		
Mussels	Cyclonaias tuberculata	Purple Wartyback	S1	G5		
Mussels	Elliptio crassidens	Elephant-ear	S2	G5		
Mussels	Epioblasma rangiana	Northern Riffleshell	S1	G2T2	E	
Mussels	Epioblasma triquetra	Snuffbox	S2	G3	E	
Mussels	Eurynia dilatata	Spike	S3	G5		
Mussels	Fusconaia flava	Wabash Pigtoe	S1	G5		
Mussels	Fusconaia subrotunda	Long-solid	S3	G3		At Risk - Cons
Mussels	Lampsilis abrupta	Pink Mucket	S1	G2	E	
Mussels	Lampsilis cardium	Plain Pocketbook	S3	G5		
Mussels	Lampsilis fasciola	Wavy-rayed Lampmussel	S3	G5		
Mussels	Lampsilis ovata	Pocketbook	S3	G5		
Mussels	Lasmigona costata	Fluted-shell	S3	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Mussels	Ligumia recta	Black Sandshell	S3	G5	—	
Mussels	Obliquaria reflexa	Threehorn Wartyback	S3	G5		
Mussels	Obovaria subrotunda	Round Hickorynut	S3	G4		
Mussels	Paetuliunio fabalis	Rayed Bean	S1	G2	E	
Mussels	Pleurobema clava	Clubshell	S1	G2	E	
Mussels	Pleurobema sintoxia	Round Pigtoe	S2	G4G5		
Mussels	Potamilus fragilis	Fragile Papershell	S3	G5		
Mussels	Ptychobranchus fasciolaris	Kidneyshell	S3	G4G5		
Mussels	Pyganodon grandis	Giant Floater	S3	G5		
Mussels	Quadrula quadrula	Mapleleaf	S3	G5		
Mussels	Strophitus undulatus	Squawfoot	S3	G5		
Mussels	Theliderma cylindrica	Rabbitsfoot	SX	G3G4		
Mussels	Tritogonia verrucosa	Pistolgrip	S3	G4G5		
Mussels	Truncilla truncata	Deertoe	S2	G5		
Plants	Calycanthus floridus var. glaucus	Carolina Allspice, Strawberry-shrub	SH	G5T5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	Carex kraliana	Kral's Sedge	S1	G5		
Plants	Carex lucorum var. austrolucorum	Blue Ridge Sedge	S1	G4T3T5		
Plants	Carex planispicata	Flat-spiked Sedge	S2	G4Q		
Plants	Hypericum drummondii	Nits-and-lice	S1	G5		
Plants	Juglans cinerea	Butternut	S3	G4		
Plants	Lygodium palmatum	American Climbing Fern	S3	G4		
Plants	Scleria oligantha	Little-head Nutrush	S1	G5		
Reptiles	Agkistrodon contortrix mokasen	Northern Copperhead	S5	G5T5		
Reptiles	Carphophis amoenus	Wormsnake	S3	G5		
Reptiles	Coluber constrictor constrictor	Northern Black Racer	SNR	G5T5		
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4	—	
Reptiles	Opheodrys aestivus	Rough Greensnake	S2	G5		
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	G5T5	R	
Snails	Glyphyalinia cumberlandiana	Hill Glyph	S3	G4		
Snails	Inflectarius rugeli	Deep-tooth Shagreen	S2	G5		
Snails	Punctum smithi	Lamellate Spot	S2	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Snails	Stenotrema macgregori	Fraudulent Slitmouth	S2	GNR		
Snails	Ventridens virginicus	Split-tooth Dome	S3	G4		
Tiger Beetles	Cicindela unipunctata	A Tiger Beetle	S3	G4G5		

- S Rank (State Rank) and G Rank (Global Rank) Conservation Status: 1= Critically Imperiled, 2 = Imperiled, 3 = Vulnerable, 4 = Apparently Secure, 5 = Secure, NR = Not Ranked, T = Subspecies or Varieties, B = Breeding, N = Non-breeding, S#S# or G#G# indicates range of uncertainty of conservation status.
- Federal Status: R = Rare, T= Threatened, E = Endangered.
- USFWS Priority At Risk (2021): Cons = need management attention, Science = need more research.

Appendix 2. Priority SGCN, Known Stresses and Actions

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Eastern Whip-poor-will	• Road/collision mortality. • Incompatible forest structure. • Possible declines in high quality prey	• Identify high density areas and install highway signage. • Manage forests for interior gaps and edges. • Long-term monitoring of insect populations
Ruffed Grouse	• Insufficient habitat. • West Nile virus	• Create suitable habitat through established BMPs. • Manage forests at landscape scale for mosaic of age classes and structure. • Assess prevalence of WNV
Broad-winged Hawk	• Poor forest structure	• Forest management for gaps
Kentucky Warbler	• Deer overherbivory. • Incompatible forest structure	• Reduce deer population. • Manage forests for structural and spatial complexity
Worm-eating Warbler	• Deer overherbivory. • Incompatible forest structure. • Residential development	• Reduce deer population. • Manage forests for structural and spatial complexity
Wood Thrush	• Deer overherbivory. • Incompatible forest structure. • Residential development	• Reduce deer population. • Manage forests for structural and spatial complexity
Yellow-breasted Chat	• Forest maturation. • Herbicide use/veg mgmt in utility corridors	• Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat

Forests and Woodlands		
Common Name	**Local Stress**	**Action**
Swainson's Warbler	• Riparian habitat loss and degradation	• Research to assess productivity and survival in breeding habitat dominated by invasive species. • Protect floodplain forests with suitable habitat
Cerulean Warbler	• Poor forest structure	• Manage forests to create suitable habitat as per CERW guidelines
Blue-winged Warbler	• Insufficient habitat. • Residential development	• Reduce clean farming practices. • Create early successional habitat
Field Sparrow	• Insufficient habitat	• Create early successional habitat
Kral's Sedge	• Unknown status	• Field survey to determine species distribution and threats.
Blue Ridge Sedge	• Unknown status	• Field survey to determine species distribution and threats.
Nits-and-lice	• Unknown status	• Field survey to determine species distribution and threats.
American Climbing Fern	• Unknown status	• Field survey to determine species distribution and threats.
Little-head Nutrush	• Unknown status	• Field survey to determine species distribution and threats.
Eastern Box Turtle	• Collection. • Disease. • Road Mortality. • Habitat destruction. • Artificial increase in mesocarnivores	• Reduce illegal collection. • Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease. • Improve road conditions to reduce mortality at identified hot spots. • Develop and distribute box turtle BMPs document for urban areas

Floodplain, Riparian and Wetland Habitats		
Common Name	**Local Stress**	**Action**
Eastern Box Turtle	• Collection. • Disease. • Road Mortality. • Habitat destruction. • Artificial increase in mesocarnivores	• Reduce illegal collection. • Educate land managers, biologists and researchers about appropriate decontamination procedures to reduce the spread of disease. • Improve road conditions to reduce mortality at identified hot spots. • Develop and distribute box turtle BMPs document for urban areas
Kentucky Warbler	• Deer overherbivory. • Incompatible forest structure	• Reduce deer population. • Manage forests for structural and spatial complexity
Swainson's Warbler	• Riparian habitat loss and degradation	• Research to assess productivity and survival in breeding habitat dominated by invasive species. • Protect floodplain forests with suitable habitat
Belted Kingfisher	• Poor water quality. • Insufficient nest microhabitat	• Identify important waterways and improve water quality
Louisiana Waterthrush	• Loss of riparian forests. • Stream degradation. • Acid deposition. Residential development	• Improve water quality. • Conserve riparian and upland stream valley forests. • Conservation easements
Field Sparrow	• Insufficient habitat	• Create early successional habitat
Baltimore Checkerspot	• Deer herbivory of host plant. • Wetland loss	• Target deer harvest near good turtlehead (Chelone glabra) populations. • Maintain wetland integrity
Nits-and-lice	• Unknown status	• Field survey to determine species distribution and threats.

Floodplain, Riparian and Wetland Habitats		
Common Name	**Local Stress**	**Action**
American Climbing Fern	• Unknown status	• Field survey to determine species distribution and threats.

Aquatic Habitats		
Common Name	**Local Stress**	**Action**
Western Sand Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Identify and mitigate causes of sedimentation (e.g., knotweed control, mining and logging BMPs etc.)
Eastern Sand Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Identify and mitigate causes of sedimentation (e.g., knotweed control, mining and logging BMPs etc.)
Redside Dace	• Increasing stream temperatures. • Increased stream sedimentation	• Restore riparian areas. • Mitigate causes of sedimentation. • BMPs by resource extraction companies
Diamond Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Identify and mitigate causes of sedimentation (e.g., knotweed control, mining and logging BMPs etc.)
Diamond Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Identify and mitigate causes of sedimentation (e.g., knotweed control, mining and logging BMPs etc.)
Spotted Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Prevent and restore causes of sedimentation, prevent river channelization
Tippecanoe Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Prevent and restore causes of sedimentation. • Prevent river channelization
Northern Brook Lamprey	• Increased sedimentation. • Stream passage barriers	• Increase stream connectedness and riparian area restoration
American Brook Lamprey	• Increased sedimentation. • Stream passage barriers	• Riparian restoration

Aquatic Habitats		
Common Name	**Local Stress**	**Action**
Popeye Shiner	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration
Mountain Madtom	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration
Northern Madtom	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration
Longhead Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration
Paddlefish	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Create and/or preserve island, shoal and sandbar habitats
Elephant-ear	• Habitat loss. • Loss of host fish	• Conservation of known beds. Manage host fish species
Snuffbox	• Habitat loss. • Loss of host fish	• Conservation of known beds. • Manage host fish species
Long-solid	• Hydroelectric dam. • Water quality	• Sediment control and water quality improvement
Pink Mucket	• Hydroelectric dam. • Water quality	• Sediment control and water quality improvement
Clubshell	• Sedimentation and in-stream work	• Erosion controls
Rabbitsfoot (currently extirpated)	• Sedimentation. • Hydraulic changes. • Water quality	• Re-introduction • Sediment control. • Water withdrawal conservation. • Unconventional Oil & Gas BMP's
Rayed Bean	• Sedimentation. • Hydraulic changes. • Water quality	• Sediment control. • Water withdrawal conservation. • Unconventional Oil & Gas BMP's

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat

Elk River Wildlife Management Area	• **Forest and Woodland**
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Rock Outcrops, Cliffs and Talus**
	  • Acidic Rock Outcrops, Cliffs, and Talus
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • River Floodplains
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Low Gradient, Warm
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Cool
		• Small River, Low Gradient, Warm
		• Small River, Moderate Gradient, Warm
		• Medium River, Low Gradient, Warm
		• Medium River, High Gradient, Warm

Morris Creek Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Rock Outcrops, Cliffs and Talus**
	  • Acidic Rock Outcrops, Cliffs and Talus
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • River Floodplains
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Developed
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

Wallback Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Rock Outcrops, Cliffs and Talus**
	  • Acidic Rock Outcrops, Cliffs and Talus
	  • Calcareous Cliffs and Talus
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • River Floodplains
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Cool
		• Headwater Creek, High Gradient, Warm

Appendix 4. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05050007000662	WVKE-9-C_00	AaronsFork	Bio, Fecal, Iron
05050007001401	WVKE-41-B_00	AdonijahFork	Fecal, Iron
05050007001524	WVKE-2-A_00	BakerFork	Iron
05050007000923	WVKE-84.5_00	BearRun	Fecal, Iron
05050007000642	WVKE-9-K_00	BigFork	Iron
05050007000639	WVKE-9-B-1_00	BigFork	Bio, Fecal, Iron
05050007000776	WVKE-64_00	BigOtterCreek	Bio, Fecal, Iron
05050007001617	WVKE-23_00	BigSandyCreek	Bio, Fecal, Iron
05050007000142	WVKE-76_01.1	BirchRiver	Fecal, Iron, Selenium
05050007000020	WVKE-14_01	BlueCreek	Iron
05050007000760	WVKE-43_00	BlueKnobCreek	Iron
05050007000779	WVKE-64-E_00	BoggsFork	Iron
05050007001530	WVKE-87-A_00	BrushFork	Iron
05050007001272	WVKE-84-A-1_00	BrushyBranch	Iron
05050007001261	WVKE-89_00	BuckeyeCreek	Iron
05050007000491	WVKE-86_00	BuffaloCreek	Iron
05050007000081	WVKE-50_01	BuffaloCreek	Fecal, Ph,Aluminum, Iron
05050007001386	WVKE-46-C-1_00	BullpenFork	Selenium
05050007004761	WVKE-9-E_00	BullskinBranch	Fecal, Iron
05050007001428	WVKE-34_00	CampCreek	Bio, Fecal, Iron
05050007004999	WVKE-46-C-2_00	CannelCoalHollow	Selenium
05050007000656	WVKE-9-I-1-B_00	CanterburyHollow	Iron
05050007001523	WVKE-4_00	CoonskinBranch	Bio, Iron
05050007004780	WVKE-7_00	CoopersCreek	Fecal, Iron
05050007001394	WVKE-46-A_00	CoveHollow	Iron
05050007003133	WVKE-84-B_00	CutlipsFork	Iron
05050007003580	WVKE-72_00	DuckCreek	Fecal, Iron
05050007001267	WVKE_03_04_05	ElkRiver	Fecal, Iron
05050007004720	WVKE_01	ElkRiver	Bio, Fecal, Iron
05050007001607	WVKE_02	ElkRiver	Bio, Fecal, Iron
05050007000518	WVKE-2_00	ElkTwomileCreek	Fecal, Iron
05050007000039	WVKE-19_00	FallingRockCreek	Fecal, Iron
05050007000637	WVKE-7-C_00	FourmileFork	Iron
05050007000528	WVKE-87_00	GrannyCreek	Bio, Fecal, Iron
05050007005104	WVKE-41-C-1_00	GrassyFork	Bio, Fecal, Iron

Reach Code	AUID	Common Name	Impairments
05050007005203	WVKE-2-E_00	GreenBottom	Bio, Fecal
05050007000127	WVKE-69_00	GrovesCreek	Fecal, Iron
05050007005003	WVKE-7-A.5_00	HallsFork	Iron
05050007000644	WVKE-9-P_00	HurricaneBranch	Bio, Fecal, Iron
05050007001511	WVKE-8_00	IndianCreek	Bio, Iron
05050007000641	WVKE-9-J_00	JakesRun	Fecal, Iron
05050007001464	WVKE-14-G-4_00	JimsFork	Iron
05050007005170	WVKE-14-K_00	JoesHollow	Ph, Aluminum, Iron
05050007001667	WVKE-20_00	JordanCreek	Fecal, Iron
05050007004853	WVKE-7-E_00	KaufmanBranch	Bio, Fecal, Iron
05050007000540	WVKE-37_00	LaurelCreek	Bio, Fecal, Iron
05050007003154	WVKE-87-B_00	LaurelFork	Bio, Fecal, Iron
05050007001292	WVKE-73-A_00	LaurelFork	Iron
05050007001501	WVKE-14-F_00	LaurelFork	Iron
05050007000553	WVKE-21_00	LeatherwoodCreek	Bio, Fecal, Iron
05050007000074	WVKE-46_00	LeatherwoodCreek	Bio, Fecal, Iron, Selenium
05050007000555	WVKE-21-B_00	LeftFork/LeatherwoodCreek	Iron
05050007001438	WVKE-26-A_00	LeftFork/MorrisCreek	Bio, Ph, Aluminum, Iron
05050007001435	WVKE-27-A_00	LeftFork/QueenShoalsCreek	Iron
05050007000665	WVKE-9-A_00	LickBranch	Iron
05050007001396	WVKE-45-B_00	LickBranch	Fecal, Iron
05050007001671	WVKE-42_00	LittleBeechyCreek	Iron
05050007005025	WVKE-7-0.5A_00	LittleCoopersCreek	Iron
05050007001673	WVKE-57_00	LittleLaurelRun	Iron
05050007005243	WVKE-84_00	LittleOtterCreek	Bio, Iron
05050007000479	WVKE-9_00	LittleSandyCreek	Bio, Fecal, Iron
05050007000559	WVKE-40_00	LittleSycamoreCreek	Iron
05050007001282	WVKE-80_00	LowerRockcampRun	Iron
05050007001452	WVKE-14-B_00	LowerThreemileFork	Iron
05050007005177	WVKE-1_00	MagazineBranch	Fecal, Iron
05050007005071	WVKE-45_00	MiddleCreek	Bio, Fecal, Iron
05050007005037	WVKE-7-A_00	MileFork	Fecal, Iron
05050007000003	WVKE-6_00	MillCreek	Iron
05050007000774	WVKE-64-D_00	MooreFork	Fecal, Iron
05050007001436	WVKE-26_00	MorrisCreek	Ph,Aluminum, Iron
05050007000024	WVKE-14-M_00	MorrisFork	Iron

Reach Code	AUID	Common Name	Impairments
05050007001664	WVKE-13_00	NarrowBranch	Fecal, Iron
05050007000632	WVKE-3_00	NewhouseBranch	Bio, Fecal, Iron
05050007001299	WVKE-70_00	O'BrionCreek	Fecal, Iron
05050007001262	WVKE-88_00	OldWomanRun	Bio, Fecal, Iron
05050007000773	WVKE-64-B_00	OtterlickRun	Iron
05050007005264	WVKE-9-I-1_00	PattersonFork	Fecal, Iron
05050007001463	WVKE-14-G-3_00	PigeonroostFork	Bio, Iron
05050007001509	WVKE-10_00	PinchCreek	Fecal, Iron
05050007000653	WVKE-9-I_00	PocaFork	Bio, Fecal, Iron
05050007000054	WVKE-30_01	PorterCreek	Bio, Fecal, Iron
05050007000055	WVKE-30_02	PorterCreek	Fecal, Iron
05050007000570	WVKE-27_00	QueenShoalsCreek	Bio, Fecal, Iron
05050007001385	WVKE-46-C_00	RightFork/LeatherwoodCreek	Bio, Iron, Selenium
05050007001460	WVKE-14-G-1_00	RightFork/SlackBranch	Iron
05050007000066	WVKE-41-C_00	RightFork/SycamoreCreek	Fecal, Iron
05050007001300	WVKE-70-A_00	RoadFork	Fecal, Iron
05050007001387	WVKE-46-D_00	RoadFork	Bio, Fecal, Iron, Selenium
05050007001280	WVKE-82_00	RockcampRun	Iron
05050007000649	WVKE-9-N_00	RuckerFork	Iron
05050007004718	WVKE-9-G_00	RuffnerBranch	Fecal, Iron
05050007001277	WVKE-84-A_00	RushFork	Iron
05050007000780	WVKE-64-C_00	RushFork	Iron
05050007001500	WVKE-14-I_00	SandlickBranch	Iron
05050007001499	WVKE-14-L_00	ShirkeyBranch	Iron
05050007001455	WVKE-14-G_00	SlackBranch	Fecal, Ph, Aluminum, Iron,
05050007000587	WVKE-74_00	StrangeCreek	Bio, Fecal, Iron_trout
05050007000599	WVKE-83_00	SugarCreek	Fecal, Iron
05050007006102	WVKE-(L1)_00	SuttonLake	Methylmerc
05050007001414	WVKE-41_00	SycamoreCreek	Fecal, Iron
05050007001291	WVKE-73_00	TateCreek	Fecal, Iron
05050007000645	WVKE-9-P-1_00	TrailBranch	Iron
05050007004743	WVKE-43.5_00	UNT/ElkRiverRM48.53	Ph,Aluminum, Iron
05050007001528	WVKE-2-D_00	UNT/ElkTwomileCreekRM6.36	Iron
05050007001265	WVKE-87-C_00	UNT/GrannyCreekRM4.16	Fecal, Iron
05050007001431	WVKE-30-L_00	UNT/PorterCreekRM5.49	Bio, Fecal, Iron

Reach Code	AUID	Common Name	Impairments
05050007001458	WVKE-14-G-2-B_00	UNT/WhiteoakForkRM1.33	Bio, Ph, Aluminum, Iron
05050007001426	WVKE-39_00	UpperBirchRun	Iron
05050007000744	WVKE-32_00	UpperKingShoalsRun	Iron
05050007000606	WVKE-78_00	UpperMillCreek	Bio, Fecal, Iron
05050007001504	WVKE-14-C_00	UpperThreemileFork	Iron
05050007005200	WVKE-2-B_00	ValleyGroveBranch	Fecal
05050007000560	WVKE-40-A_00	WadeFork	Iron
05050007001457	WVKE-14-G-2_00	WhiteoakFork	Bio, Ph, Aluminum, Iron
05050007000466	WVKE-9-B_00	WillsCreek	Bio, Fecal, Iron
05050007000432	WVKE-64-D-1_00	WilsonFork	Fecal, Iron
05050007000659	WVKE-9-F_00	WolfpenBranch	Fecal

Appendix 5. Partners and Assistance Provided

The table below lists partners and assistance provided to landowners for wildlife conservation actions in the CFA.

Partner	Role/Assistance Provided
American Forest Foundation (AFF) https://www.forestfoundation.org/ https://www.familyforestcarbon.org/	• The American Forest Foundation's mission is to deliver meaningful conservation impact through the empowerment of family forest landowners. • The American Tree Farm System (ATFS) recognizes landowners for their good stewardship and adhering to the ATFS Standards of Sustainability while meeting their own goals and objectives for their land. • The Family Forest Carbon Program focuses on two specific practices: Growing Mature Forests (encouraging Forest Management Plans) and Enhancing the Future Forest (control of competing vegetation to improve regeneration before or after a regeneration harvest)
Appalachian Mountains Joint Venture (AMJV) https://amjv.org/	• The Appalachian Mountains Joint Venture (AMJV) is a regional partnership of state and federal agencies, conservation organizations, and universities who work to restore and sustain viable populations of native birds and their habitats in the Appalachian Mountains. AMJV works with partners to provide private landowners with guidance and opportunities to improve habitat for birds and other wildlife.
Consulting Foresters https://wvforestry.com/forestry-consultants/	• Developing Forest Stewardship Plans • Promoting Forestry BMPs • Designing forest management practices to achieve landowner goals and ecological objectives • Assisting landowners with developing forest carbon projects aimed at achieving verifiable carbon sequestration through improved forest management practices

Partner	Role/Assistance Provided
County Farmland Protection Boards http://wvfp.org/	• County Farmland Protection Boards and West Virginia Agricultural Land Protection Authority are authorized through WV Department of Agriculture, under the Voluntary Farmland Protection Act, to • Assist in sustaining the farming community • Provide sources of agricultural products within the state for citizens of the state • Control the urban expansion which is consuming the agricultural land, topsoil and woodland of the state • Curb the spread of urban blight and deterioration • Protect agricultural land and woodland as open-space land • Enhance tourism • Protect worthwhile community values, institutions & landscapes which are inseparably associated with traditional farming
County Planning Commissions	• Planning to manage floodplains and guide new development
Forest Certification Programs: • American Tree Farm System (ATFS) https://www.treefarmsystem.org/ • Sustainable Forestry Initiative (SFI) https://www.forests.org/ https://www.wvfa.org/sfi/ • Forest Stewardship Council (FSC) https://fsc.org/en	• Resources, assistance and certification for sustainable forest management on public and private lands
Kanawha County Extension Master Gardeners Association (KCEMGA) https://extension.wvu.edu/kanawha/master-gardeners	• The West Virginia University Extension Master Gardener Program is a volunteer educational program meeting the horticultural needs of everyday West Virginians. The program trains volunteers, utilizing their expertise to teach others more about plants, their culture, their importance to the environment and to our quality of life. • Master Gardener volunteers provide technical assistance to their local county Extension office in order that consumer horticultural activities and programs can be more effectively and efficiently delivered to more people.

Partner	Role/Assistance Provided
Kanawha County Master Naturalists (KCMN) https://www.facebook.com/KanawhaValleyMasterNaturalists/ http://www.mnofwv.org/	• The mission of the West Virginia Master Naturalist Program is to train interested people in the fundamentals of natural history, nature interpretation and teaching, and to instill in them an appreciation of the importance of responsible environmental stewardship. The program will also provide a corps of highly qualified volunteers to assist government agencies, schools, and non-government organizations with research, outdoor recreation development, and environmental education and protection.
Kanawha County Department of Planning and Development https://kanawha.us/planning-development/	• The Planning and Development Department oversees and enforces land use ordinances in the unincorporated areas of Kanawha County. Currently the ordinances in effect in Kanawha County include flood plain regulations, subdivision regulations, public nuisances and property maintenance, adult only establishments, salvage yards, and video lottery.
Land Conservation Organizations • County Farmland Protection Boards http://wvfp.org/ • West Virginia Land Trust https://www.wvlandtrust.org/	• Conservation easements to protect farms, forests and riparian areas
Master Naturalists Program http://mnofwv.org/	• Training interested people in the fundamentals of natural history, nature interpretation and teaching. • Instilling an appreciation of the importance of responsible environmental stewardship. • Providing a corps of highly qualified volunteers to assist government agencies, schools and non-government organizations with research, outdoor recreation development and environmental education and protection

Partner	Role/Assistance Provided
National Wild Turkey Federation (NWTF) https://www.nwtf.org/	• Provides information to landowners on hunting and habitat management for wild turkey and other wildlife • Partners with state and federal agencies on hunting access and habitat management for wild turkey and other wildlife species
Outdoor Heritage Conservation Fund (OHCF) https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/	• The Outdoor Heritage Conservation Fund (OHCF) protects lands that host West Virginia's wild and wonderful natural resources. The OHCF's land-protection projects can include important wildlife habitats, working forests and farmlands, as well as hunting, fishing, and outdoor recreational areas. The OHCF is working to protect the best of our natural resources for all West Virginians.
Ruffed Grouse Society/American Woodcock Society (RGS) https://ruffedgrousesociety.org/#	• Creates healthy forest habitat for the benefit of ruffed grouse, American woodcock and other forest wildlife • Works with landowners and government agencies to develop critical habitat using scientific management practices • RGS works with the forest product industry, including landowners, foresters, loggers, and forest product manufacturers, to scale impacts. https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/
The Conservation Fund (TCF) https://www.conservationfund.org/where-we-work/west-virginia	• Works with public, private and nonprofit partners to protect America's legacy of land and water resources through land acquisition, sustainable community and economic development, and leadership training, emphasizing the integration of economic and environmental goals.
The Nature Conservancy https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/	• Assist land conservation organizations with forest and land protection and restoration • Assist landowners with protection and improved management of large forest tracts through conservation easements and forest carbon projects • Manages a network of nature preserves and conservation easements for conservation and recreation

Partner	Role/Assistance Provided
Trout Unlimited • http://www.wvtu.org/ • http://www.tu.org/	• Plans and implements restoration projects with landowners and in coordination with USFWS Partners program and USDA Natural Resource Conservation Service and Forest Service and other partners • Projects focus on riparian corridor and in-stream habitat restoration, invasive weed treatment and aquatic passage barrier removal/replacement to benefit brook trout and other wildlife species
US Army Corps of Engineers (USACE): Great Lakes and Ohio River Division https://www.lrd.usace.army.mil/ • Environmental Stewardship https://www.lrd.usace.army.mil/Missions/Environmental/ • Flood Risk Management: https://www.lrd.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/	• The Great Lakes and Ohio River Division civil works missions provide navigation, flood risk management, environmental, emergency response, recreation, hydropower, water supply and regulatory permits. • Through Environmental Stewardship, ACOE works to restore degraded ecosystem structure, function and dynamic processes to a more natural condition through large-scale ecosystem restoration projects • Flood risk management includes operation of dams, reservoirs and levees along the Ohio River and its tributaries
US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program https://www.fws.gov/northeast/ecologicalservices/partners.html	• Provides technical and financial assistance to private landowners for restoration and enhancement of fish and wildlife habitat for the benefit of Federal Trust species (Migratory Birds, Threatened and Endangered and At-Risk Species) • Efforts focus on controlling nonnative invasive plants, managing livestock access to forests, wetland restoration, riparian buffer planting and fencing, in-stream habitat improvement, aquatic passage barrier removal and creating pollinator habitat • Works in coordination with the USDA Natural Resources Conservation Service farm bill programs, Trout Unlimited and other partners

Partner	Role/Assistance Provided
USDA Farm Service Agency https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP) • State Acres for Wildlife Enhancement (SAFE) • Farmable Wetlands Program (FWP) • Grasslands Reserve Program (GRP)	• CRP provides rental payments to agricultural producers participating voluntarily to safeguard environmentally sensitive land, conserve water quality, control soil erosion and enhance wildlife habitat, including floodplain wetlands. • CREP provides extra incentives and payments to eligible producers to reduce soil erosion and pollution, improve water quality and enhance terrestrial and aquatic wildlife habitat through practices such as riparian buffers and wetland restoration • The State Acres for Wildlife Enhancement (SAFE) Initiative provides farmers and landowners with assistance to establish wetlands, grasses and trees to enhance important wildlife populations by creating critical habitat and food sources, while protecting soil and water health. • The Farmable Wetlands Program (FWP) provides farmers and ranchers annual rental payments in return for restoration wetlands and wetland buffers zones. • The Grassland Reserve Program (GRP) provides farmers a rental payment to voluntarily prevent grazing and pasture land from being converted into cropland or urban development.

Partner	Role/Assistance Provided
USDA Natural Resources Conservation Service: https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/ • Environmental Quality Incentive Program (EQIP) • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP) • Climate Smart Forestry Activities	• EQIP provides cost-share to forest and agricultural landowners targeting for activities such as forestry and grazing BMPs, reduction of nutrient, sediment and pesticide pollution, stream restoration and wildlife habitat enhancement, including stream buffers • Working Lands for Wildlife is a partnership between NRCS and USFWS to work with agricultural producers and forest land managers on habitat conservation for seven at-risk species, including Golden-winged Warbler • The RCPP-EQIP Cerulean Warbler Initiative is designed to enhance Cerulean Warbler habitat and increase their populations • The RCPP-EQIP WV Aquatic Passage-Working Farms project is a partnership between NRCS, TU and USFWS designed to improve fish and aquatic wildlife habitat, reduce infrastructure risk and increase flood resiliency. • CSP provides payments to farm and forest landowners for actively managing, maintaining and expanding conservation activities to enhance natural resources and improve their business operations. Priority resource concerns for funding include terrestrial habitat for wildlife and invertebrates. • AMA provides technical and financial assistance to agricultural producers on a voluntary basis to address issues such as water management, water quality and erosion control by incorporating conservation into their farming operations. • ACEP is a voluntary program providing technical and financial assistance to landowners for both agricultural land easements and wetland reserve easements to protect farmland and wetland habitat. • Climate-Smart Agriculture and Forestry Mitigation Activities may deliver quantifiable reductions in greenhouse gas emissions and/or increases in carbon sequestration. Many offer co-benefits that help operations build climate change resilience while addressing other natural resource concerns such as soil health, water quality, pollinator and wildlife habitat, and air quality.

Partner	Role/Assistance Provided
West Virginia Land Trust (WVLT) https://www.wvlandtrust.org/	• WVLT's mission is to protect land with significant conservation values through the use of conservation easements and real estate acquisitions, and by working with a statewide network of partners to build a passionate land conservation movement in the state.
West Virginia University Extension Service (WVU Extension): • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife	• Landowner technical assistance and information on financial assistance for forest and wildlife management • Training workshops and conferences on forestry Best Management Practices and safety practices
West Virginia University Extension Service (WVU Extension): • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife	• Landowner technical assistance and information on financial assistance for forest and wildlife management • Training workshops and conferences on forestry Best Management Practices and safety practices

Partner	Role/Assistance Provided
WV Conservation Agency (WVCA) and Conservation Districts http://www.wvca.us/ • Ag Enhancement Program (AgEP) • Non-Point Source Program • Stream Partners Program	• The Ag Enhancement Program (AgEP), administered by Conservation Districts and the WVCA, offers technical and financial assistance to implement conservation best management practices for the reduction of nutrients and sediment entering waterways and increasing farm profitability and sustainability. Practices may include invasive species management and exclusion fencing to protect streams, wetlands and other environmentally sensitive areas. • Through Conservation Districts, the statewide Non-Point Source Program uses federal Clean Water Act, Section programs to reduce nonpoint source pollution related to agriculture, construction and urban stormwater management. • Through the Stream Partners Program, WVDNR, WVCA, WVDOF and WVDEP provide grants up to $5,000 to citizens' groups who want to improve, restore, protect, study or celebrate the state's rivers and streams.

Partner	Role/Assistance Provided
WV Department of Environmental Protection (WVDEP) • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx • Rehabilitation Environmental Action Plan (REAP) https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx • WVDEP Youth Environmental Program (YEP) https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx • Spill Prevention Response Plan Guidance for Above Ground Storage Tanks https://dep.wv.gov/WWE/ee/tanks/abovegroundstoragetanks/Pages/SpillPreventionResponsePlanRequirements.aspx	• Supports partners and citizen-based watershed organizations in restoring impaired watersheds • Provides assistance in proper installation and maintenance of Best Management Practices • Provides funding for projects by watershed groups and partners to improve water quality in watersheds listed as impaired, including the Greenbrier River and many tributaries • Practices include wastewater treatment, agricultural BMPs, rain gardens for stormwater runoff, streambank restoration and community outreach • Save our Streams provides training for volunteers to monitor local wadable streams and rivers • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects • Provides spill prevention response plan guidance for above ground storage tanks
WV Department of Health and Human Resources (WVDHHR) • On-Site Sewage Program https://www.wvdhhr.org/phs/sewage/index.asp	• Provides rule interpretation and technical assistance on conventional and non-conventional on-site sewage systems, including information on septic systems, installers, permits, fees and loan programs.

Partner	Role/Assistance Provided
WV Division of Forestry (WVDOF) http://www.wvforestry.com/	• Oversees the Managed Timberland Program to provide tax incentives for landowners who manage their forest land sustainably according to a management plan • Oversee timber sales and Best Management Practices • Provides training workshops for loggers on safety and Best Management Practices • Maintains list of consulting foresters who can help landowners with Forest Stewardship Plans to enhance wildlife habitat • Protection of large private forest tracts through Forest Legacy Program
WV Division of Natural Resources (WVDNR) http://www.wvdnr.gov/wildlife/wdpintro.shtm	• Identification of SGCN and rare communities • Education, outreach and teaching resources • Field guides, Landscaping and Management guidelines • Fish and game management • Habitat restoration assistance • Natural Areas Program

Appendix 6. Resources

The following resources may provide additional information to landowners and partners seeking to manage habitat for priority SGCN in this CFA.

Long Range Plan for the Elk Conservation District Summarizes natural resources conditions and ranks resource concerns that could be addressed through NRCS technical and financial assistance. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/eqip/?cid=nrcseprd1167606
National Wild Turkey Foundation- Landowner's Toolbox https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf-tool-box
Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf
Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners. https://www.allaboutbirds.org/bbimages/clo/pdf/GWWA-APPLRegionalGuide_130808_lo-res.pdf

Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors: https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf
West Virginia Pollinator Handbook – A Field Office Technical Guide Reference to management of pollinators and their habitats. Developed by WV NRCS Ecological Sciences in conjunction with WV Division of Natural Resources and the Xerces Society for Invertebrate Conservation. http://xerces.org/sites/default/files/publications/12-049.pdf
West Virginia Invasive Species Strategic Plan and Voluntary Guidelines, 2014 https://eos.ucs.uri.edu/seagrant_Linked_Documents/mdu/2014-09_RO_Anderson_M_INV-3b.pdf
Fighting Invasive Plants in West Virginia http://www.wvnps.org/FightingInvasives.pdf
Brochures about Aquatic Invasive Species, Forest Pests and Pathogens and Invasive Plant Species https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/
American Forest Foundation: Woodland owners planning tool for forest management https://mylandplan.org/

The Nature Conservancy Resilient Land Mapping Tool and Documents: http://maps.tnc.org/resilientland/
USDA Forest Service, Northern Research Station's Climate Change Atlas: documentation of current and possible future distribution of 134 tree species and 147 bird species in the Eastern United States https://www.fs.fed.us/nrs/atlas/
Rudnick, D.A. et al. 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America. https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities
Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science: https://adaptationworkbook.org/
U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information and subject matter expertise to build climate resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location. https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice

Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition, 2016, published by the USDA Forest Service, Northern Research Station https://www.nrs.fs.fed.us/pubs/52760
Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture. https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf