Action Plan for the Cumberlands West Conservation Focus Area

May 5, 2023

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List of Acronyms Used

ACEP- Agricultural Conservation Easement Program
AFF- American Forest Foundation
AMJV- Appalachian Mountain Joint Venture
ARRI- Appalachian Regional Restoration Initiative
ATFS- American Tree Farm System
BMPs- Best Management Practices
B-Rank- Biodiversity Rank
CFA- Conservation Focus Area
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
FSA- Farm Service Agency
FSC- Forest Stewardship Council
G Rank- Global Rank
GWWA- Golden-winged Warbler
HUC- Hydrologic Unit Code
NRCS- Natural Resources Conservation Service
NWTF- National Wild Turkey Foundation
OHCF- Outdoor Heritage Conservation Fund
OSMRE- Office of Surface Mining Reclamation and Enforcement
RGS- Roughed Grouse Society
SFI- Sustainable Forestry Initiative
SGCN- Species of Greatest Conservation Need
S Rank- State Rank
SWAP- State Wildlife Action Plan
TCF- The Conservation Fund
TNC- The Nature Conservancy
TU- Trout Unlimited
USDA- United States Department of Agriculture
USDOI -United Stated Department of Interior
USFWS- United States Fish and Wildlife Service
WVCA- West Virginia Conservation Agency
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
WVLT- West Virginia Last Trust
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 Cumberlands West 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, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, and developed and agricultural habitats. It also identifies 40 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 as 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.

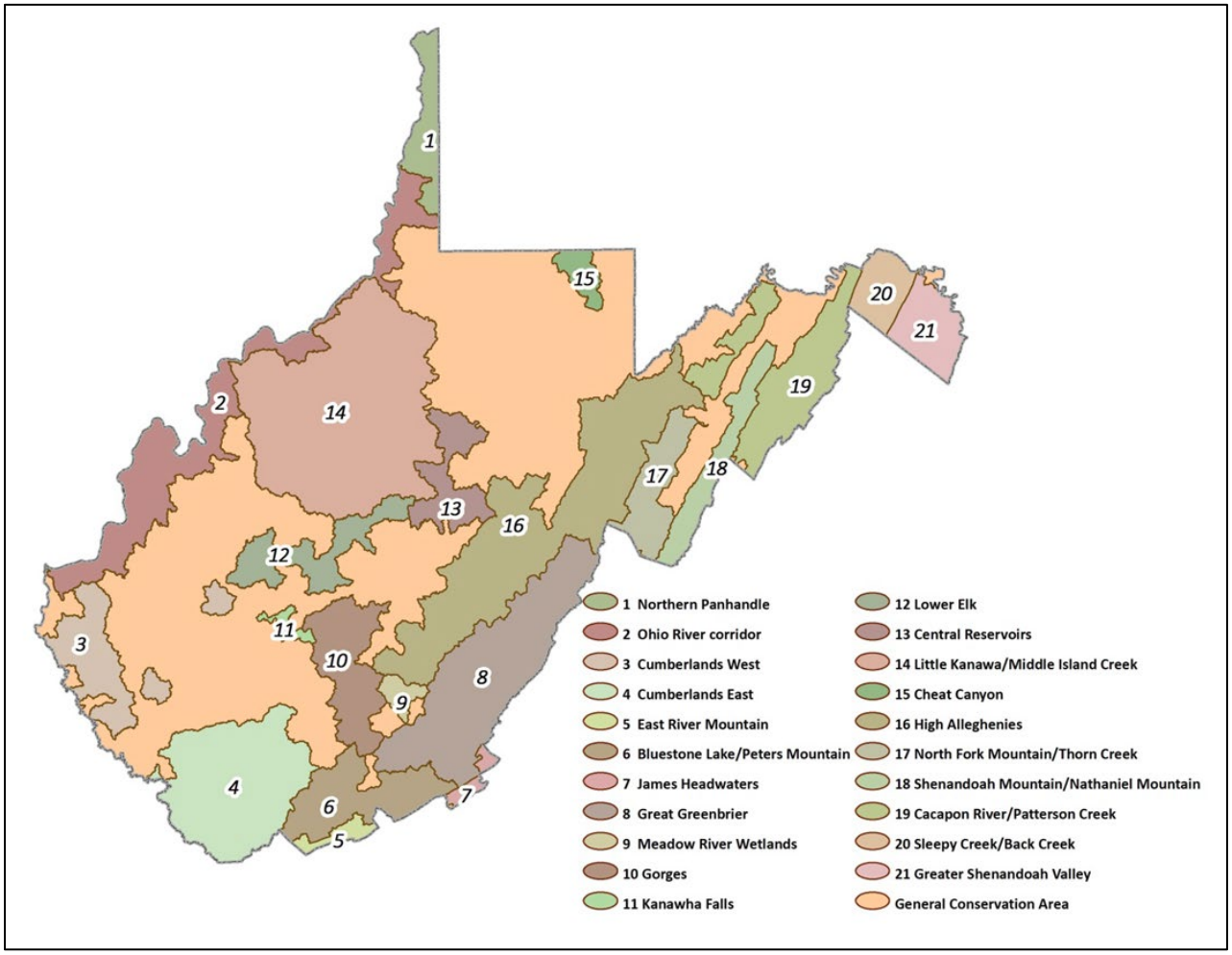
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve 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

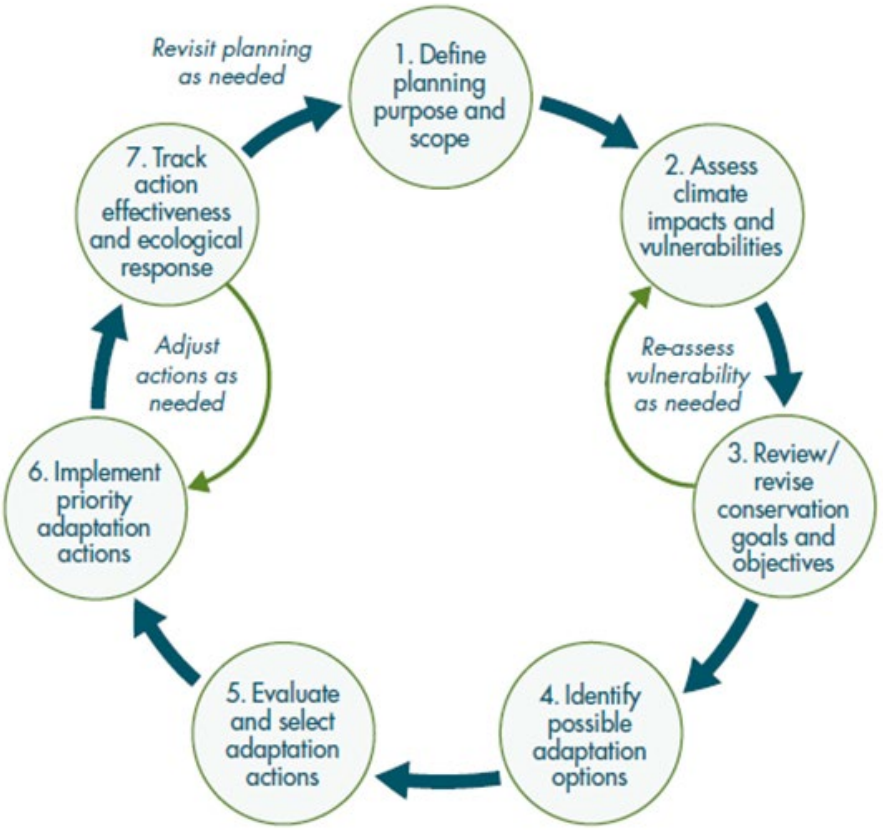
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, 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, rock outcrops, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural 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

Cumberlands West Conservation Focus Area

Overview

This Cumberlands West Conservation Focus Area (CFA) is located in the westernmost part of the state and spans across parts of the Cumberland Mountains and Western Allegheny Plateau ecoregions. This is a rugged, highly dissected landscape with sometimes-steep ridges and narrow valleys and small hollows. It is comprised of three disjunct areas:

1. The Kanawha State Forest unit
2. The Chief Logan State Park unit
3. The Western Lands unit.

Ridgetops are dominated by Dry Oak (-Pine) and Dry-Mesic Oak forests while the valleys and lower elevations are mainly Mixed Mesophytic and Cove Hardwood forests.

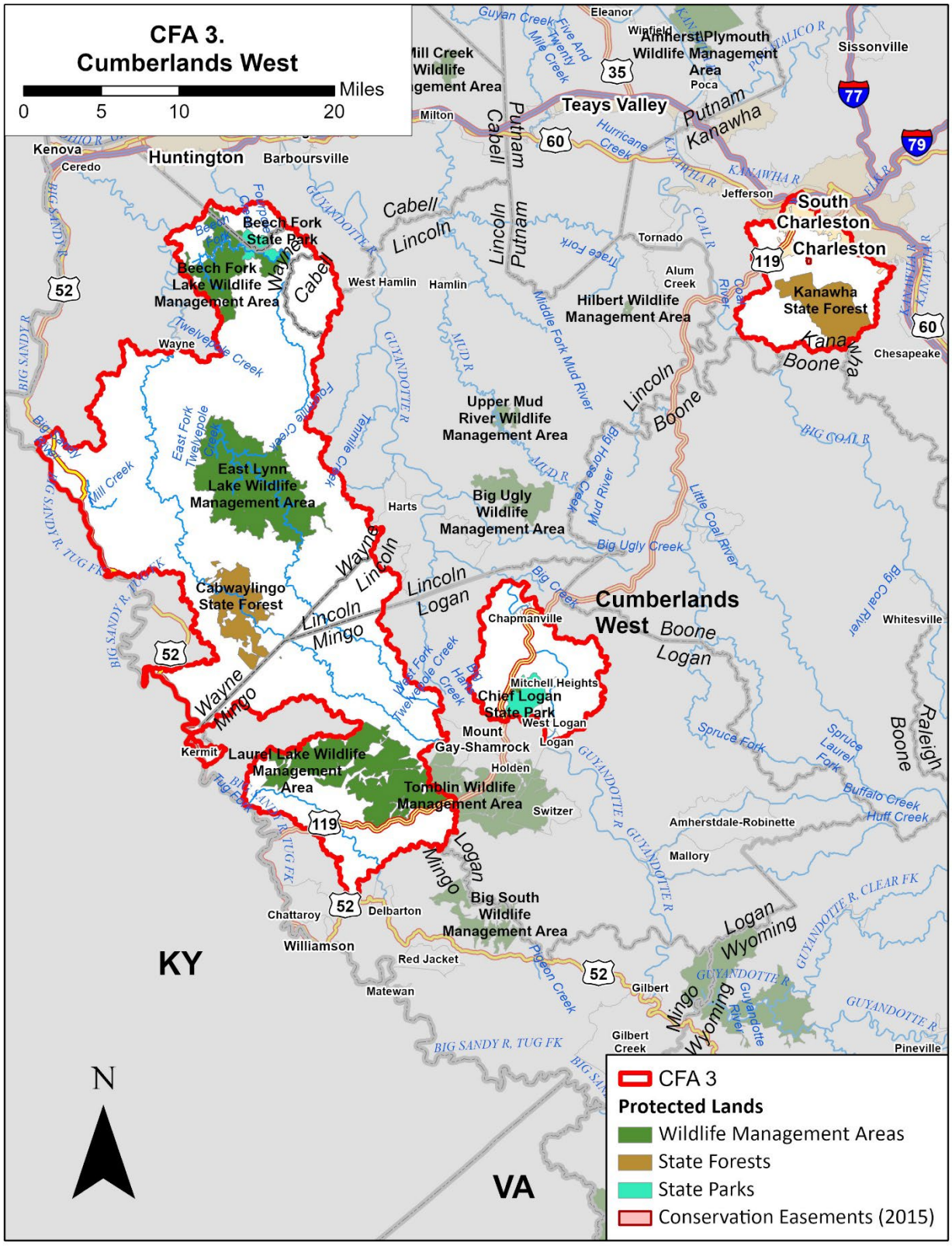
Numerous small streams dissect the landscape and mostly flow into:

- Guyandotte River
- Big Sandy River
- Ohio River

The main conservation areas in this CFA are centered on public lands managed as state forests, state parks and wildlife management areas. The US Army Corps of Engineers own lands associated with reservoirs. The landscape remains largely forested, with some medium-sized blocks of relatively unfragmented forest, primarily on public land. Human population densities are relatively low; however large population centers including Charleston and Huntington are nearby.

Deep mine and surface coal mine areas exist within the CFA, but not as extensively as in nearby areas. Forested land is primarily in small to medium sized, private non-industrial property blocks mixed with industrial forest land.

Map 2. Overview



Habitats

The Cumberlands West CFA includes a variety of terrestrial, aquatic, and subterranean habitat types.

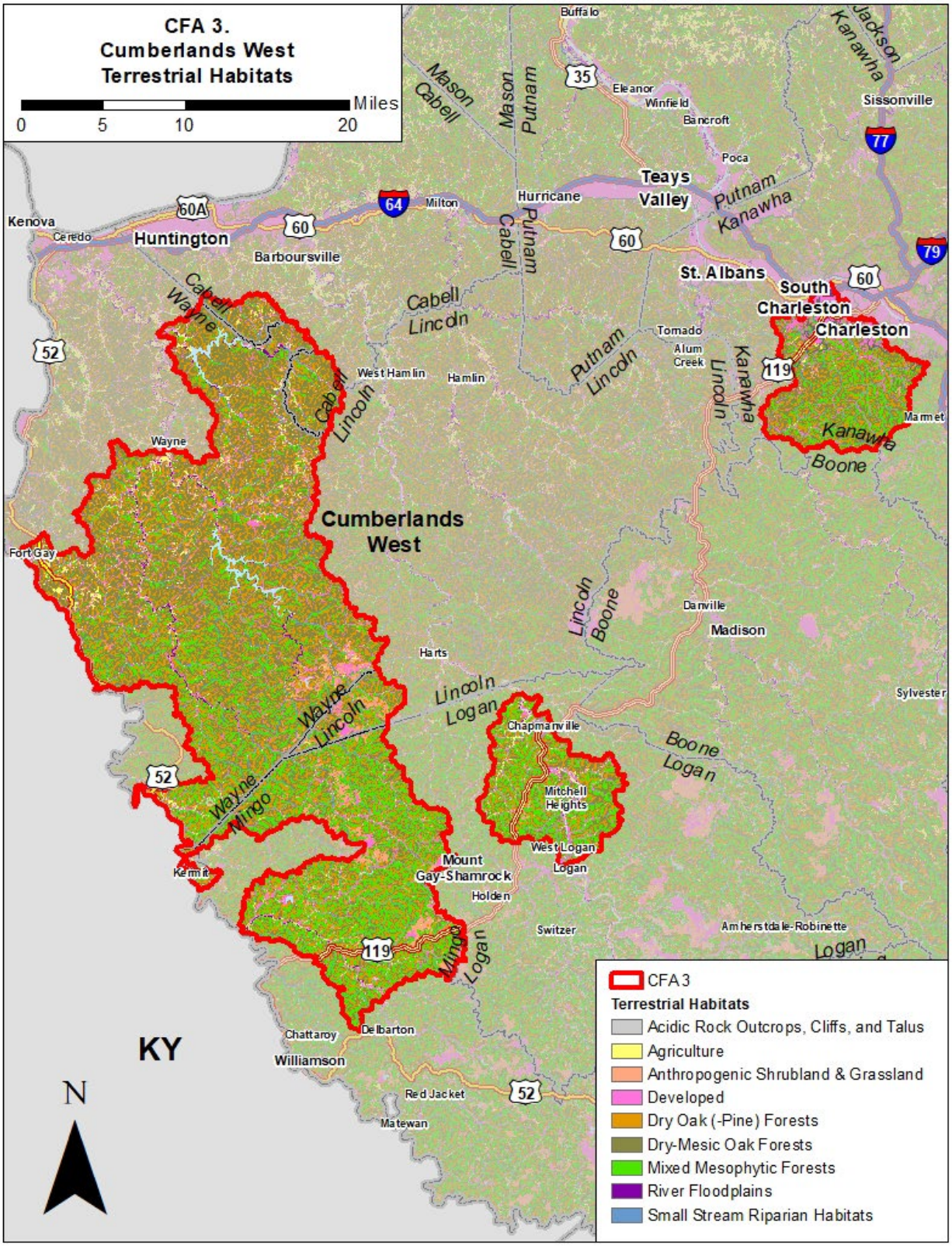
Terrestrial Habitats

Nine of the habitat types described in the SWAP are present in this CFA, including 10% of the state's Anthropogenic Shrubland and Grassland. Dry-Mesic Oak Forests, while being the most abundant terrestrial habitat type in the CFA, makes up only 4% of the state's total habitat for that type. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat	Acres in CFA	% of CFA Area	% of WV Total for Type
Acidic Rock Outcrops, Cliffs, and Talus	1,000	0.24%	1.11%
Agriculture	7,988	1.95%	0.56%
Anthropogenic Shrubland & Grassland	17,362	4.24%	10.91%
Developed	32,191	7.85%	2.83%
Dry Oak (-Pine) Forests	94,680	23.09%	3.83%
Dry-Mesic Oak Forests	153,487	37.44%	3.03%
Mixed Mesophytic Forests	88,454	21.58%	3.00%
River Floodplains	2,172	0.53%	1.81%
Small Stream Riparian Habitats	8,869	2.16%	1.79%
Unresolved	3,755	0.92%	3.22%
Totals	409,958	100.00%	

Map 3. Terrestrial Habitats



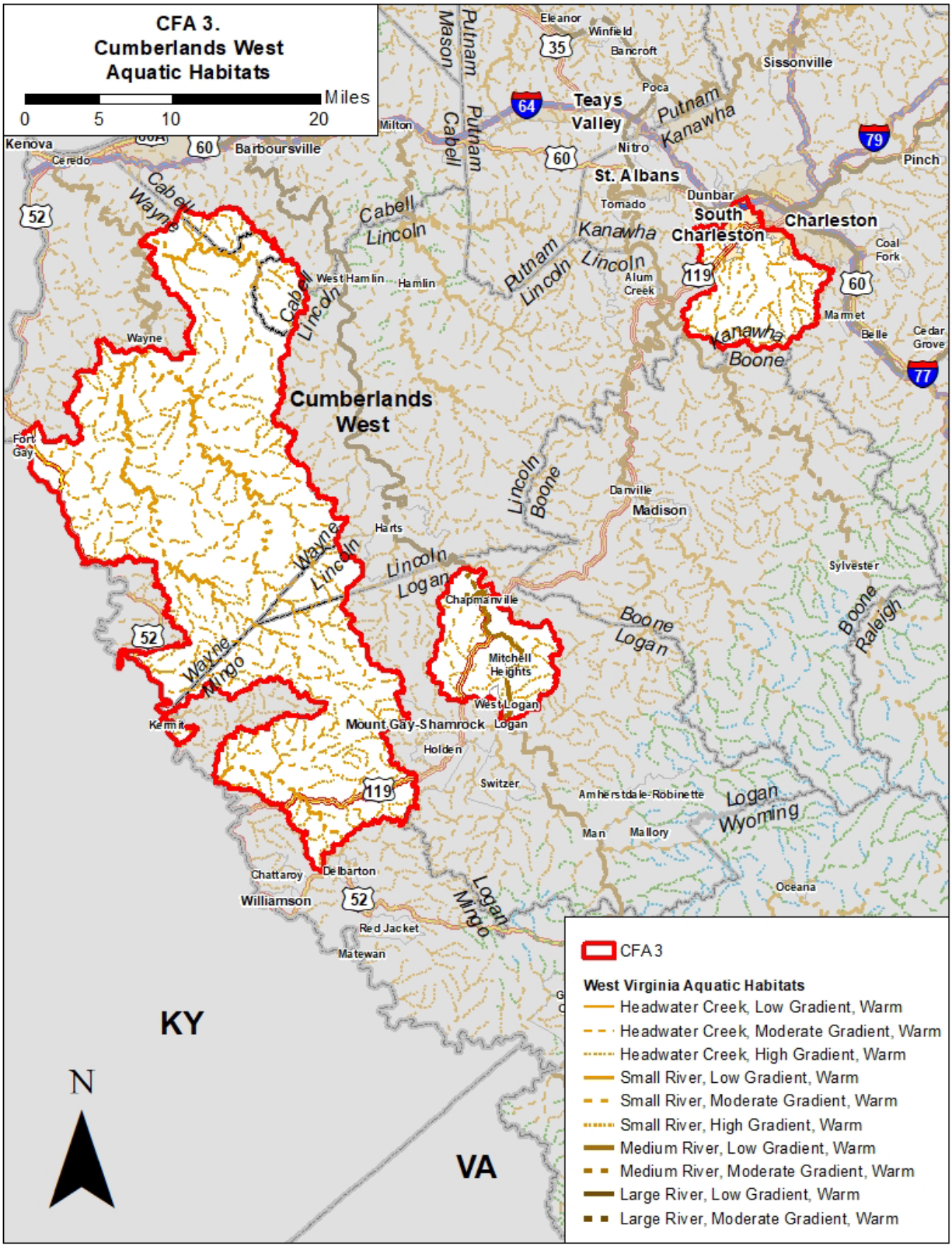
Aquatic Habitats

Ten of the aquatic habitat types described in the SWAP are present within the Cumberlands West CFA, including over 40% 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	Miles in CFA	% of CFA Area	% of WV Total for Type
Headwater Creek, Low Gradient, Warm	27	3.47%	4.83%
Headwater Creek, Moderate Gradient, Warm	303	39.04%	7.76%
Headwater Creek, High Gradient, Warm	329	42.43%	43.35%
Small River, Low Gradient, Warm	45	5.82%	9.82%
Small River, Moderate Gradient, Warm	44	5.62%	8.04%
Small River, High Gradient, Warm	0	0.02%	1.08%
Medium River, Low Gradient, Warm	13	1.62%	2.64%
Medium River, Moderate Gradient, Warm	3	0.44%	0.98%
Large River, Low Gradient, Warm	11	1.41%	1.88%
Large River, Moderate Gradient, Warm	1	0.13%	0.91%
Totals	776	100.00%	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

The table 3 lists the number of SGCN in each taxa listed in the SWAP for the Cumberlands West CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	10
Birds	25
Butterflies and Moths	7
Crayfish	2
Dragonflies and Damselflies	9
Fish	22
Mammals	9
Mussels	17
Other Invertebrates	2
Plants	47
Reptiles	16
Snails	6
Tiger Beetles	1
Totals	**173**

Although heavily degraded, streams in the Cumberlands West CFA remain biologically significant containing:

- 22 fish Species of Greatest Conservation Need (SGCN) including Redside Dace, American Brook Lamprey, and Mountain Madtom.
- 17 mussel SGCN

Two regionally endemic crayfish occur in this CFA:

- Coalfields Crayfish
- Tug Valley Crayfish

The rivers (Big Sandy, Tug Fork, and Guyandotte) and especially their tributaries provide habitat for many rare species that occur nowhere else in the state. Blocks of forest and embedded patch habitats support relatively high densities of a number of forest interior bird species of special concern including:

- Wood Thrush
- Louisiana Waterthrush
- Worm-eating Warbler
- Kentucky Warbler
- Cerulean Warbler

The CFA is the only known West Virginia populations for:

- Guyandotte Beauty
- Sandstone Fire-pink

This CFA contains one of two known maternity colonies of Rafinesques Big-eared Bat in West Virginia. Kanawha and Cabwaylingo State Forests support notably diverse and abundant nesting forest interior birds and rare plants and animals.

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:

- Forest habitat loss and fragmentation from coal mining, private roads, and gas wells and pipelines are widespread
- Water pollution and sedimentation from mining, other resource development, residential use, and all-terrain vehicle (ATV) recreation can impact aquatic habitats.

In addition to this list of general stresses, this Action Plan will list more specific 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.

Land Protection - Protect remaining intact forest areas, especially on and near public lands.

Aquatic Habitat Restoration - Direct mitigation resources to restoring key aquatic systems.

Terrestrial Habitat Restoration - Restore legacy mined lands.

Terrestrial Habitat Conservation - Work with mine and gas companies to reduce forest habitat loss and fragmentation when planning mine and gas well development and associated infrastructure.

Terrestrial Habitat Management - Provide guidance to corporate landowners on practices benefitting forest interior birds.

Collaborative Conservation Actions - Establish guidelines for ATV parks and trail systems that protect both the terrestrial and aquatic habitats.

This Action Plan will also 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 Division of Forestry
- WV Department of Environmental Protection
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Appalachian Mountains Joint Venture
- Motorized recreational trail groups
- Corporate landowners

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 and planning workshops during CFA planning, planning and implementation of conservation actions, and monitoring effectiveness. 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:

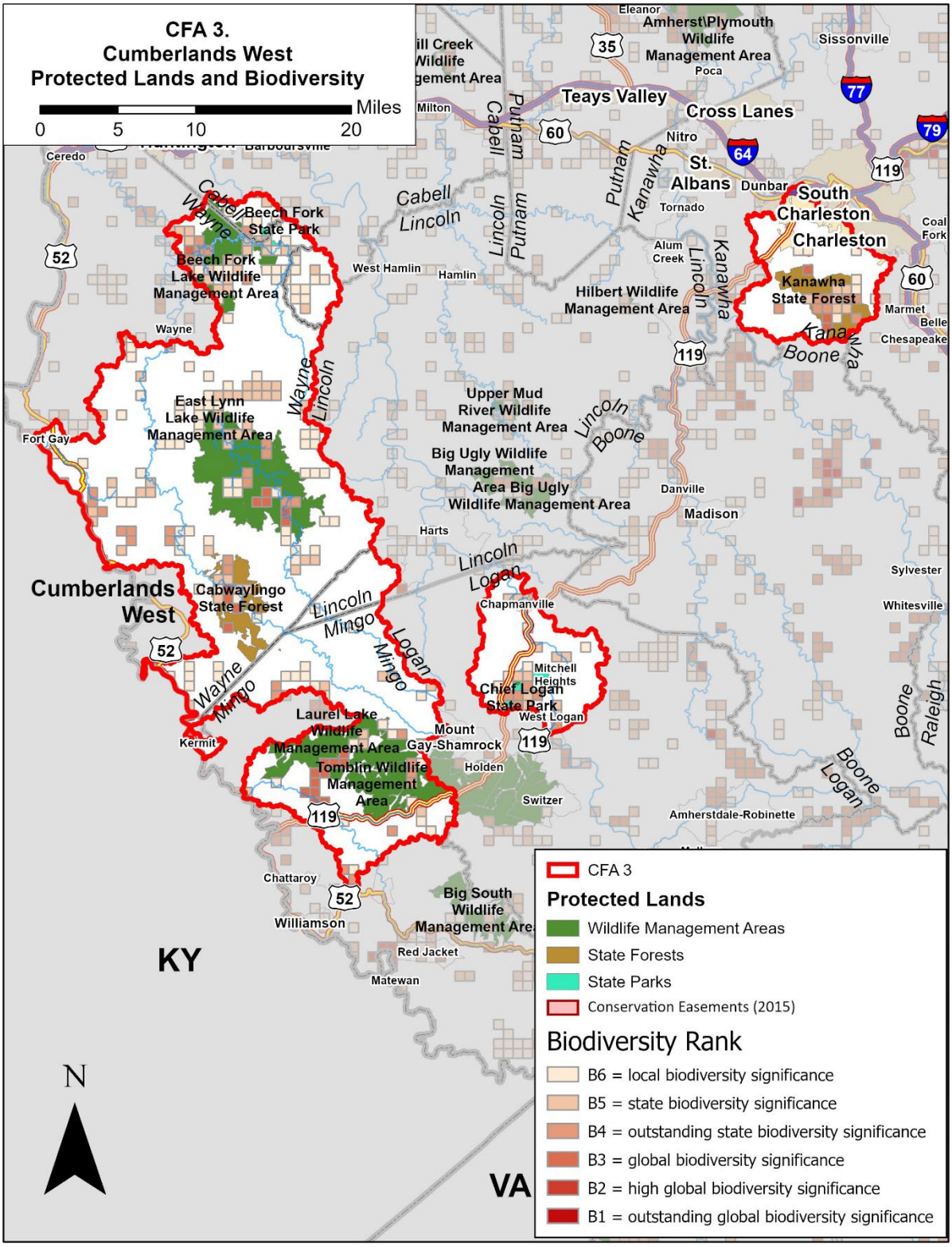
- Beech Fork Lake WMA
- East Lynn Lake WMA
- Laurel Lake WMA
- Cabwaylingo State Forest
- Kanawha State Forest
- Beech Fork Lake State Park
- Chief Logan State Park

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. There are also conservation opportunities on private lands. The Ward Hollow Wildlife Habitat is a unique partnership certified by the Wildlife Habitat Council to enhance and protect wildlife habitat for numerous species on 150 acres of land owned by the Dow Chemical corporation in South Charleston. In addition, the West Virginia Land Trust holds conservation easements on private lands within the CFA that may protect important wildlife habitat and provide additional wildlife conservation opportunities.

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 communicates occur on public lands in the CFA, 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 to work with private landowners to restore and protect biodiversity on private lands.

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
Amphibians	Aneides aeneus	Green Salamander	S3	G3G4
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5
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	Piranga rubra	Summer Tanager	S3B	G5
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4
Birds	Setophaga discolor	Prairie Warbler	S3B	G5
Birds	Spizella pusilla	Field Sparrow	S3B,S3N	G5
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5
Butterflies & Moths	Celastrina nigra	Dusky Azure	S3	G4
Butterflies & Moths	Pieris virginiensis	West Virginia White	S3	G2
Butterflies & Moths	Satyrium caryaevorus	Hickory Hairstreak	S2	G4
Butterflies & Moths	Speyeria diana	Diana Fritillary	S2S3	G3G4
Crayfish	Cambarus theepiensis	Coalfields Crayfish	S3	GNR
Dragonflies & Damselflies	Anax longipes	Comet Darner	S3	G5
Dragonflies & Damselflies	Dromogomphus spoliatus	Flag-tailed Spinyleg	SH	G4G5
Dragonflies & Damselflies	Enallagma antennatum	Rainbow Bluet	S1S2	G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Dragonflies & Damselflies	Progomphus obscurus	Common Sanddragon	S2S3	G5
Fish	Ammocrypta pellucida	Eastern Sand Darter	S3	G3
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4
Fish	Cottus sp. 1	Bluestone Sculpin	S1	G2
Fish	Lethenteron appendix	American Brook Lamprey	S2	G4
Fish	Noturus eleutherus	Mountain Madtom	S2	G4
Fish	Phenacobius mirabilis	Suckermouth Minnow	S3	G5
Mammals	Corynorhinus rafinesquii	Eastern Big-eared Bat	S1	G3G4
Other Invertebrates	Hansonoperla hokolesqua	A Stonefly	S1	G2
Plants	Asplenium bradleyi	Bradley's Spleenwort	S1	G4
Plants	Cleistes bifaria	Small Rosebud Orchid	S1	G4?
Plants	Melothria pendula var. pendula	Creeping Cucumber, Guadeloupe Cucumber	S1	G5?
Plants	Monotropsis odorata	Sweet Pinesap	S1	G3
Plants	Silene rotundifolia	Sandstone Fire-pink	S1	G4
Plants	Trichomanes boschianum	Appalachian Bristle Fern	S1	G4
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	G5T5

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, Dry Oak Pine, and Mixed Mesophytic Forests are the most abundant forest habitat types present and can be found throughout the CFA. Southern stretches of the CFA are most heavily composed of Mixed Mesophytic Forests, transitioning into Dry Oak Pine and Dry-Mesic Oak Forests as you progress north. While Dry Mesic Oak, Dry Oak Pine, and Mixed Mesophytic Forests compose more than two thirds of the total habitat type in the CFA, each habitat only represents around 3% of the corresponding total habitat type for the state. Many of these 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 opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches also provide a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change. However, many of the biodiversity elements occur outside of the larger forest patches, and may be vulnerable to disturbance.

Priority Species

Below is a list priority species in the CFA associated with forest and woodland habitats.

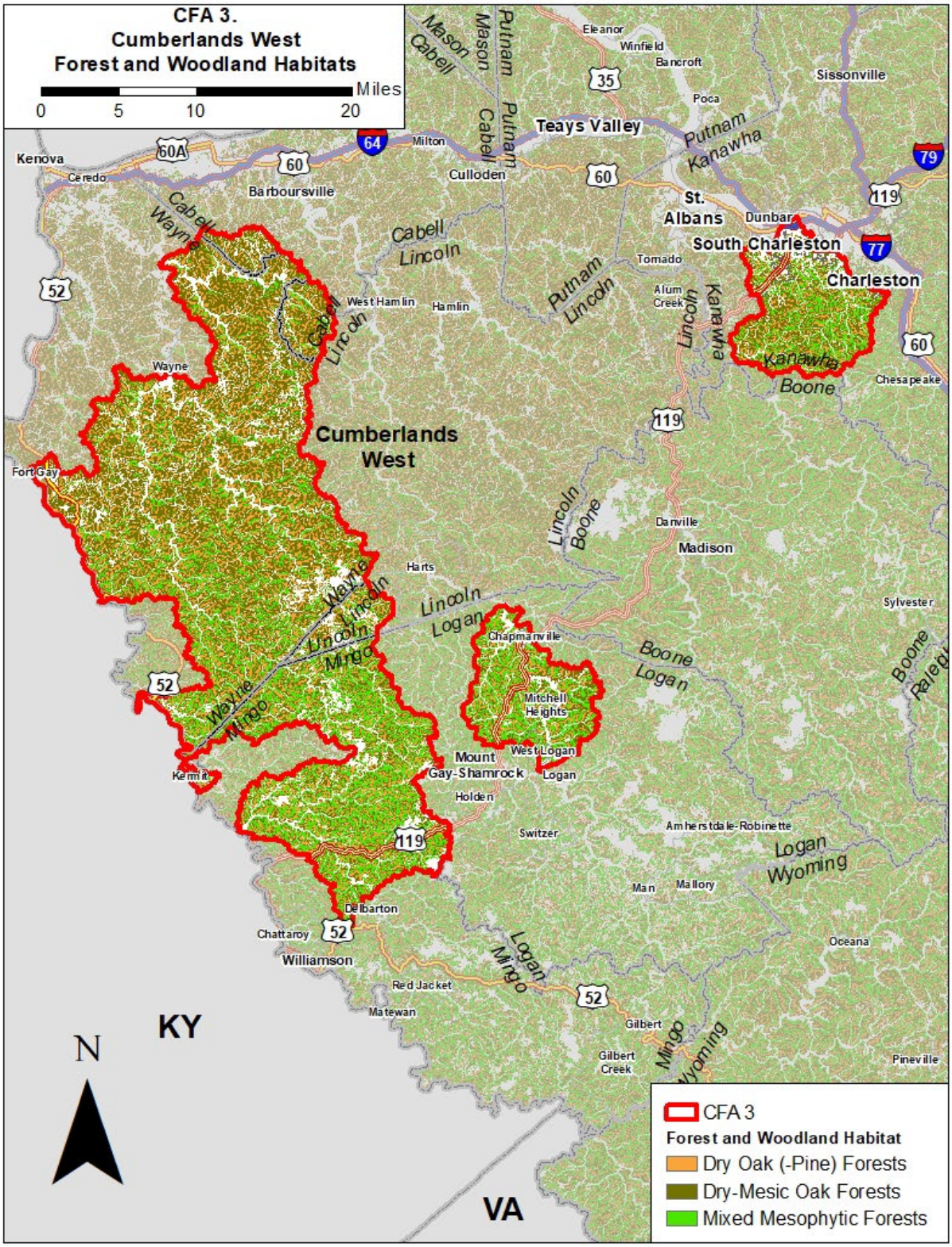
Table 5. Priority Species in Forest and Woodland Habitats

Taxa	**Scientific Name**	**Common Name**
Amphibians	Aneides aeneus	Green Salamander
Birds	Antrostomus vociferus	Eastern Whip-poor-will
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
Birds	Piranga rubra	Summer Tanager
Birds	Setophaga cerulea	Cerulean Warbler
Birds	Setophaga discolor	Prairie Warbler
Birds	Vermivora cyanoptera	Blue-winged Warbler
Butterflies and Moths	Celastrina nigra	Dusky Azure

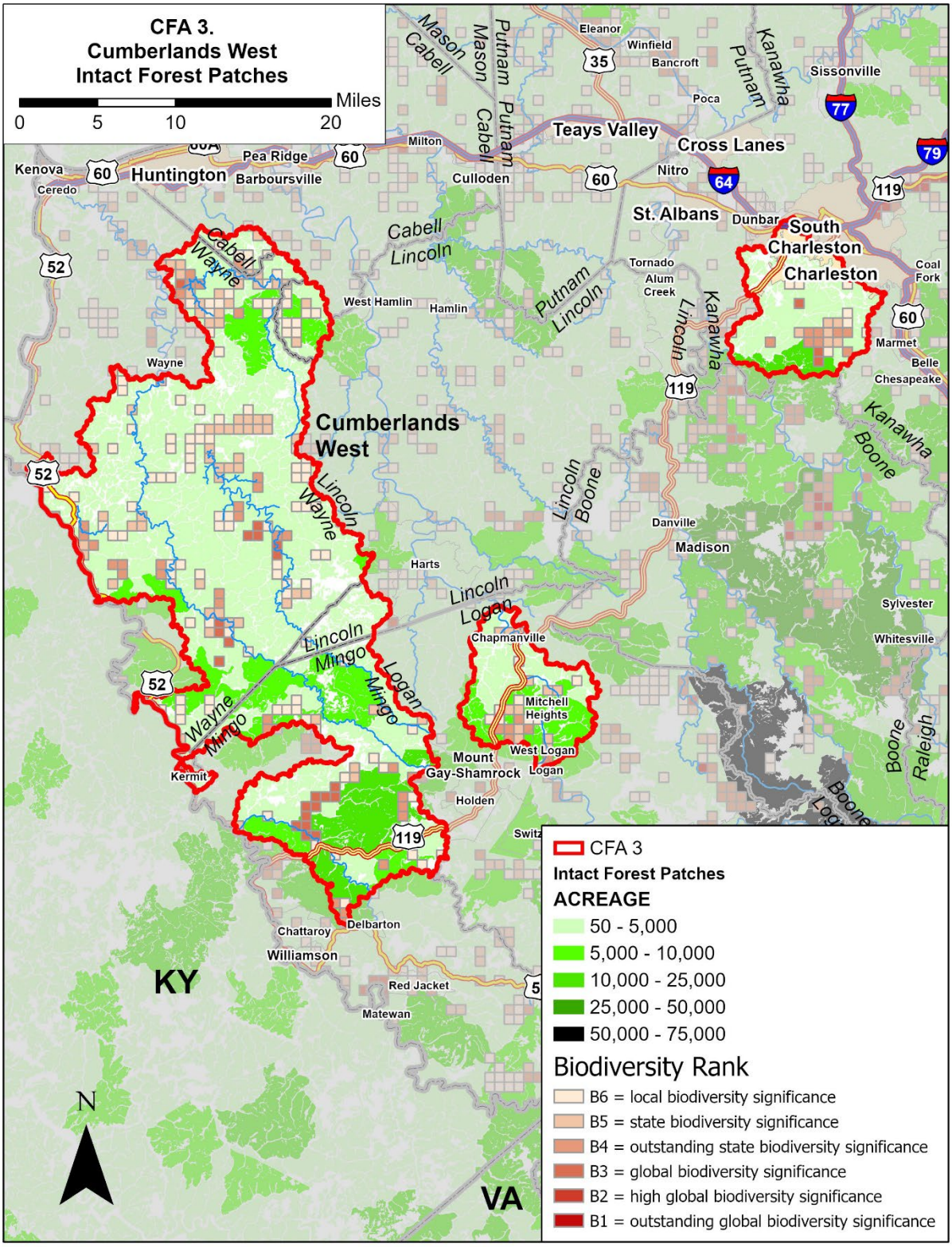
Taxa	Scientific Name	Common Name
Butterflies and Moths	Pieris virginiensis	West Virginia White
Butterflies and Moths	Satyrium caryaevorus	Hickory Hairstreak
Butterflies and Moths	Speyeria diana	Diana Fritillary
Mammals	Corynorhinus rafinesquii	Eastern Big-eared Bat
Plants	Asplenium bradleyi	Bradley's Spleenwort
Plants	Melothria pendula var. pendula	Creeping Cucumber, Guadeloupe Cucumber
Plants	Monotropsis odorata	Sweet Pinesap
Reptiles	Crotalus horridus	Timber Rattlesnake
Reptiles	Terrapene carolina carolina	Eastern Box Turtle

Larger, intact forest patches support many forest interior breeding birds, including Broad-winged Hawk, Wood Thrush, Cerulean Warbler and Worm-eating Warbler, while early successional forest habitats support the Prairie Warbler and Blue-winged Warbler.

Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



Habitat Stresses and Conservation Actions

Table 6 lists stresses impacting species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses.

Table 6. Habitat Stresses and Conservation Actions in Forest and Woodland Habitats:

Habitat Stress	**Conservation Action**
Forest fragmentation associated with coal mining, roads, gas wells and pipelines	Protect large intact forest patches, especially on or near public lands; Work with mine and gas companies to reduce forest habitat loss and fragmentation when planning mine and gas well development and associated infrastructure
Deforestation and disturbance of rare habitats	Maintain and protect forest cover, especially around boulder fields, rock outcrops, cliffs, talus, caves, and other rare habitat features; Follow Forestry BMPs developed by White Nose Syndrome Response team.
Poor forest structure	Manage forests for structural and spatial complexity and habitat diversity
Interior forest: deforestation, fragmentation, poor forest structure	Implement practices to benefit forest interior birds, including protection of mature forest with structural complexity: old growth, small openings with well-developed understories, snags and decaying logs; Provide guidance to corporate landowners
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management to promote early successional habitat and structural complexity, including gaps and edges, outside of interior forests
Invasive weeds: forest fragmentation, climate change	Maintain forest cover and control invasive weeds, especially around rare habitat features. Pull garlic mustard.
Deer overabundance, poor forest structure	Manage local deer populations where abundant
Loss of basking/ gestation/ denning habitat for timber rattlesnake	Use forest management to create canopy gaps; reduce canopy over known gestation and basking sites; develop basking structures; avoid impact to dens
Incompatible utility corridor management	Improve vegetation management practices in utility corridors to create compatible habitat
Surface mining, mowing and removal of nectar resources	Mine reclamation using Forest Reclamation Approach including native wildflowers. Work with WV DOH to maintain roadside wildflowers and nectar resources.

Habitat Stress	Conservation Action
Roadside maintenance, spraying herbicides and mowing impacts on rare plants	Survey to locate and avoid populations of rare plants
Road collision/mortality (Eastern Whip-poor-will and Eastern Box Turtles)	Install highway signage in high density areas
Forest habitat impacts form uncontrolled ATV access	Establish guidelines for ATV parks and trail systems to protect important forest habitat

In addition to the habitat-linked stresses listed above, direct stresses to priority species include the collection, mowing and non-target herbicide impact on rare plants, collection and killing of timber rattlesnakes, bat mortality due to white nose syndrome, and disease and road mortality of Eastern Box Turtles. Training for land managers, biologists and researchers about appropriate decontamination procedures may reduce the spread of disease among box turtles. Several species of rare plants, butterflies and moths and require additional surveying to determine their current status and threats.

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 habitats are needed for priority SGCNs.

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 and Pine-Oak Rocky Woodlands 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.

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 linkages between them, may further enable their adaptation and shifting distribution across the landscape.

Table 7 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 7. 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 • Manage 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 calcareous forests, woodlands, and glades • 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 8. Implementation Plan for Forest and Woodland Habitats

Action	Partners	Effectiveness Measures
Protection of Forest Habitat, especially large patches in and around public lands: • Conservation Easements • Land Acquisition • Natural Area designation on State Lands	• OHCF, TCF, TNC, WVLT • WVDOF Forest Legacy • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Protection of Forest Habitat, especially large patches in and around public lands: • Incentive Programs • Forest Carbon projects	• USDA NRCS • Consulting Foresters • ATFS, FSC, SFI • AFF, TNC	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Work with mine and gas companies to reduce forest habitat loss and fragmentation when planning mine and gas well development and associated infrastructure	• Mine and gas companies • WVDNR • WVDEP • USDOI OSMRE	• Acres of intact forest patches protected from fragmentation • Abundance and diversity of priority species and habitats in protected forest patches
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 • NWTF and RGS • USDA NRCS • WVDOF • WVU Extension • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Develop and Implement Plans to Manage Forest Habitats • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs	• AMJV • AFF • AFTS, FSC, SFI • Consulting Foresters • Planning Commissions • Public Land Managers • Kanawha State Forest Foundation • Beech Fork Lake State Park Foundation • USDA NRCS • WVDOF • Forest Carbon Programs	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Promote diversity of native species and age classes in forested areas, and restore native forest vegetation on adjacent degraded lands through planting and silviculture	• AMJV • WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Provide guidance to corporate landowners on practices benefitting forest interior birds	• AMJV • USDA NRCS • WVDNR • WVDOF • WVFA/SFI • Public Land Managers • Wildlife Habitat Council	• 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)	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • NWTF and RGS • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
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.	• WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers • Kanawha State Forest Foundation • Beech Fork Lake State Park Foundation	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Restore mined lands using Forest Reclamation Approach.	• WVDEP DMR • USDOI OSMRE • Mine owners	• 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	• WVDOF • WVCA and GVCD • USDA NRCS • Public Land Managers • Kanawha State Forest Foundation • Beech Fork Lake State Park Foundation • Dow Chemical/Ward Hollow Wildlife Habitat	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Manage deer population	• WVDNR (hunting licenses) • Private landowners • Public Land Managers	• Change in deer population or forest structure • Acres of habitat restored for priority species • 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
Provide guidance on timber rattlesnake den avoidance	• WVU Extension • Public land managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
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

Action	Partners	Effectiveness Measures
Provide pollinator habitat including mine reclamation using Forest Reclamation Approach with native wildflowers, and work with WV DOH to maintain roadside wildflowers and nectar resources.	• WVDOH • WVDEP DMR • USDOI OSMRE • Dow Chemical/Ward Hollow Wildlife Habitat	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Survey to locate and avoid populations of rare roadside plants	• WVDOH • WVDNR • Public Land Managers	• Acres of habitat protected for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Install highway signage to avoid collisions with priority species in high density areas	• WVDOH • WVDNR	• Install highway signage to avoid collisions with priority species in high density areas
Establish guidelines for ATV parks and trail systems to protect important forest habitat	• WVDNR • Public Lands Managers • Trail System Managers	• Miles or acreage of trails with habitat protections in place • Before and after comparison: abundance, diversity, and distribution of priority species

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.

Rock Outcrops, Cliffs and Talus Habitats

Acidic rock outcrops, cliffs, and talus can be found in the southern portions of the CFA, most heavily clustered along the path of US route 119. These habitats are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Map 8 illustrates the location of these rare habitat types, and those in smaller forest patches may be more vulnerable to stresses.

Priority Species

Below is a list priority species in the CFA associated with Acidic Rock Outcrops, Cliffs and Talus Habitats.

Table 9. Priority Species in Acidic Rock Outcrops, Cliffs and Talus Habitats

Taxa	Scientific Name	Common Name
Amphibians	Aneides aeneus	Green Salamander
Reptiles	Crotalus horridus	Timber Rattlesnake
Plants	Silene rotundifolia	Sandstone Fire-pink

Acidic rock outcrops, cliffs and talus support many unique species, such as the Green Salamander and Timber Rattlesnake. While the majority of rocky habitat species have evolved adaptations to disturbance events; climate change and the increasing occurrence of disturbances could lead to further endangerment of rare species.

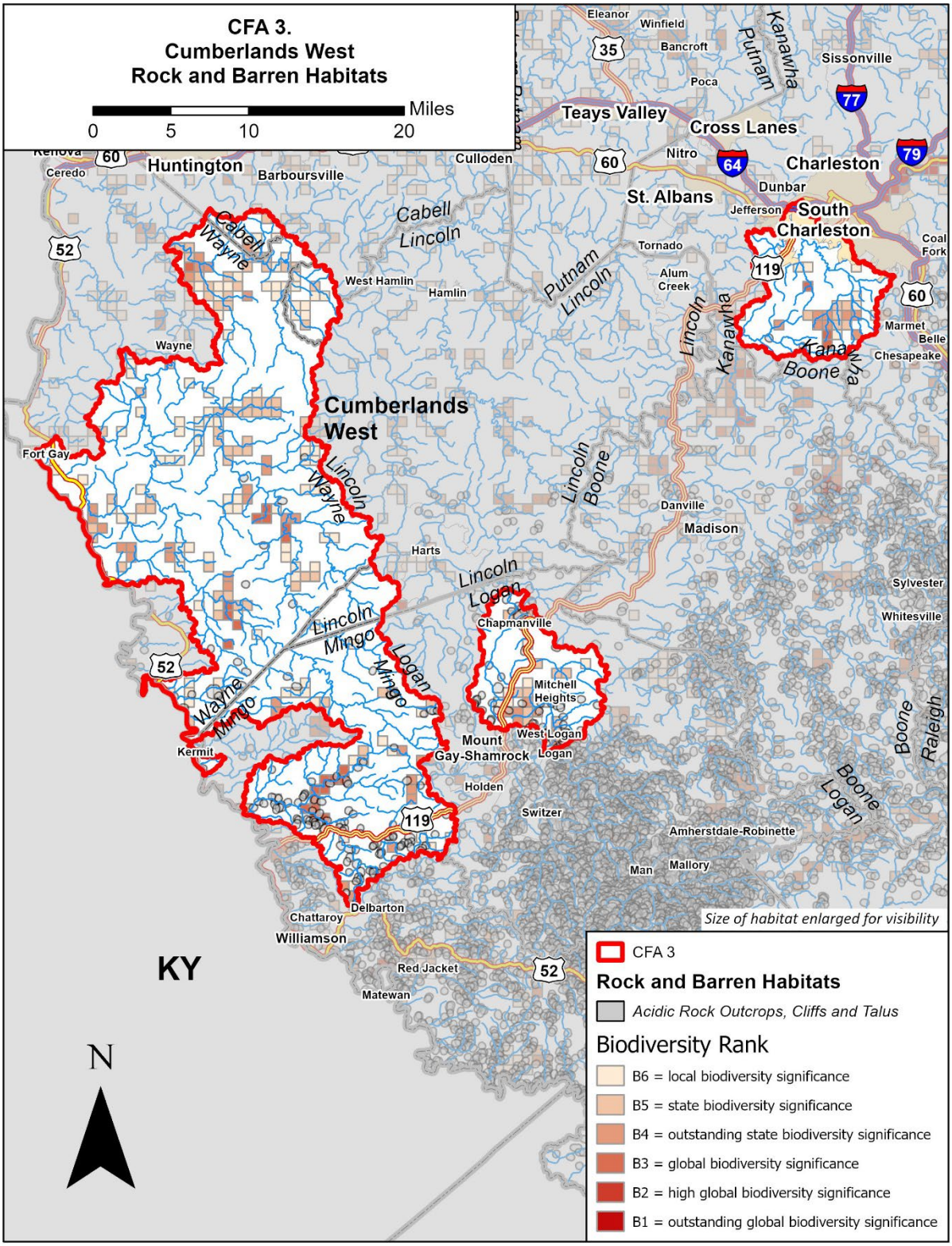
Habitat Stresses and Conservation Actions

The following stresses to these sensitive habitats may be addressed through the actions below.

Table 10. Habitat Stresses and Conservation Actions in Acidic Rock Outcrops, Cliffs and Talus Habitats

Habitat Stress	Conservation Action
Recreation, trampling of rare plants, habitat disturbance and loss of forested buffers	• Maintain and protect forested buffers surrounding rock outcrops, boulder fields, cliffs and talus habitat • Manage recreational use to reduce habitat impacts
Loss of basking/ gestation/ denning habitat for timber rattlesnake	• Use forest management to create canopy gaps • Reduce canopy over known gestation and basking sites • Develop basking structures; avoid dens

Map 8. Rock Outcrop, Cliff & Talus Habitats



Climate Change and Habitat Resilience

As described in The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et. al, 2015), ecosystems that are limited by geological features 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 nonnative invasive plants. Maintaining intact forest ecosystems around these rare habitats, and controlling invasive species, may help maintain resilience to a changing climate.

Table 11. Climate Stresses and Resilience Actions in Acidic Rock Outcrop, Cliff and Talus Habitats

Climate Stresses	Habitat Resilience Actions
• Increased risk of drought and wildfire • Increased frequency and severity of storms • Increased competition from nonnative invasive species	• Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Protect refugia for rare habitats and plant communities • Maintain intact, resilient forest habitat in surrounding 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 shale barrens, acid rock outcrops, and calcareous cliffs and talus.

Table 12. Implementation Plan for Acidic Rock Outcrop, Cliffs and Talus Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition • Natural Area designation on State Lands	• WVDOF Forest Legacy • WV Land Trust • The Nature Conservancy • The Conservation Fund • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Incentive Programs	• USDA NRCS	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Re-vegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species	• WVDOF • WVCA and GVCD • USDA NRCS • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Identify, protect, create and maintain forest canopy gaps and avoid timber rattlesnake gestation and basking sites; develop basking structures.	• WVDBR • WVU Extension • USDA NRCS • WVDOF • Consulting Foresters	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
Manage recreation on sensitive sites	• Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species

Human Benefits

Actions to restore rock outcrop, cliffs and talus, and shale barren habitat may provide human health and economic benefits for local residents and communities, including hunting, wildlife viewing, tourism, and recreational opportunities.

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from warm, low-gradient headwater streams such as the West Fork Twelvepole Creek, to warm, moderate gradient, large sized rivers such as Tug Fork. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are closely 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

Below are lists of priority aquatic species in the CFA that occur in aquatic, riparian and floodplain habitats.

Table 13. Priority Species in Aquatic Habitat

Taxa	Scientific Name	Common Name
Crayfish	Cambarus theepiensis	Coalfields Crayfish
Fish	Ammocrypta pellucida	Eastern Sand Darter
Fish	Clinostomus elongatus	Redside Dace
Fish	Cottus sp. 1	Bluestone Sculpin
Fish	Lethenteron appendix	American Brook Lamprey
Fish	Noturus eleutherus	Mountain Madtom
Fish	Phenacobius mirabilis	Suckermouth Minnow
Other Invertebrates	Hansonoperla hokolesqua	A Stonefly

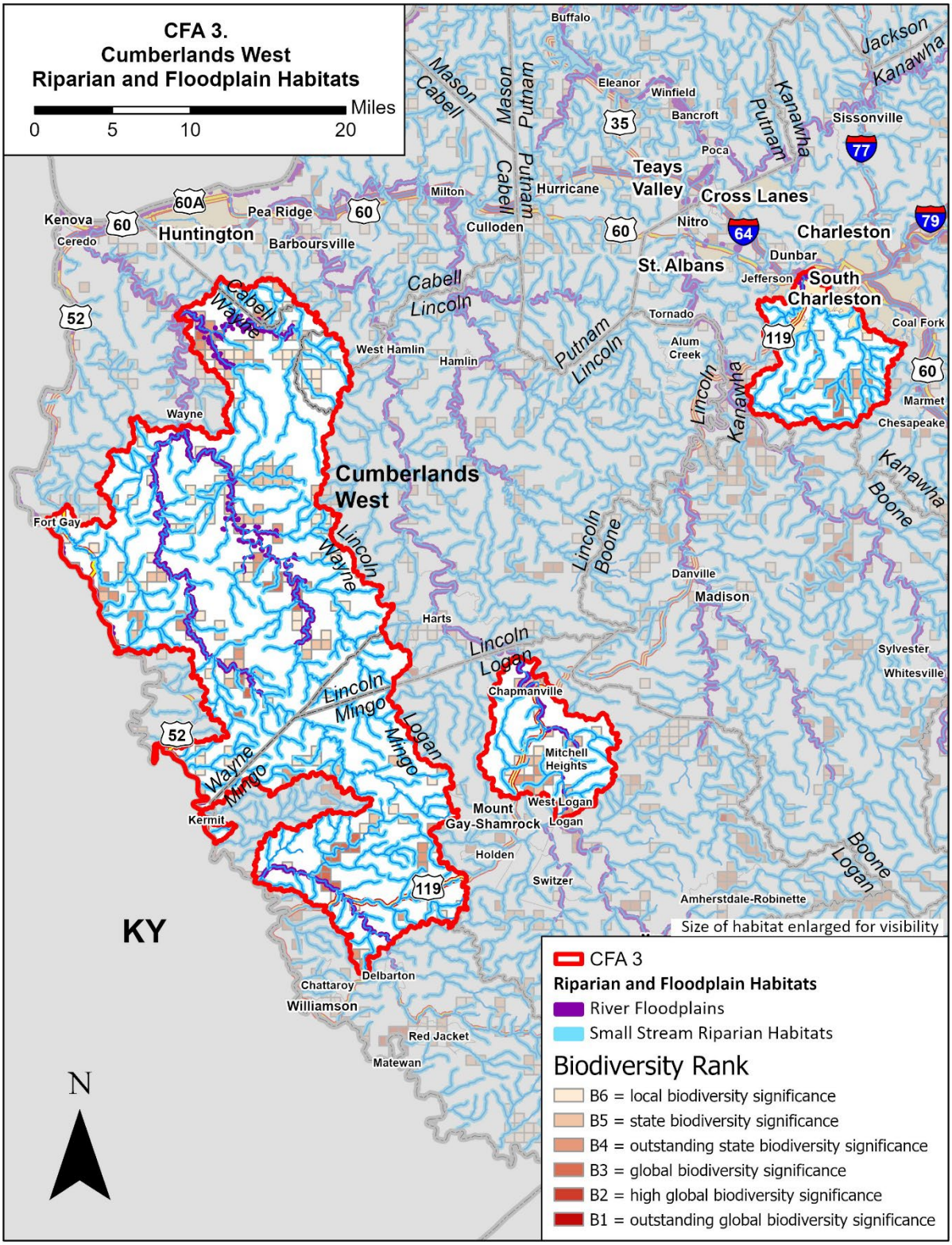
Table 14. Priority Riparian and Floodplain Species

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
Butterflies and Moths	Celastrina nigra	Dusky Azure

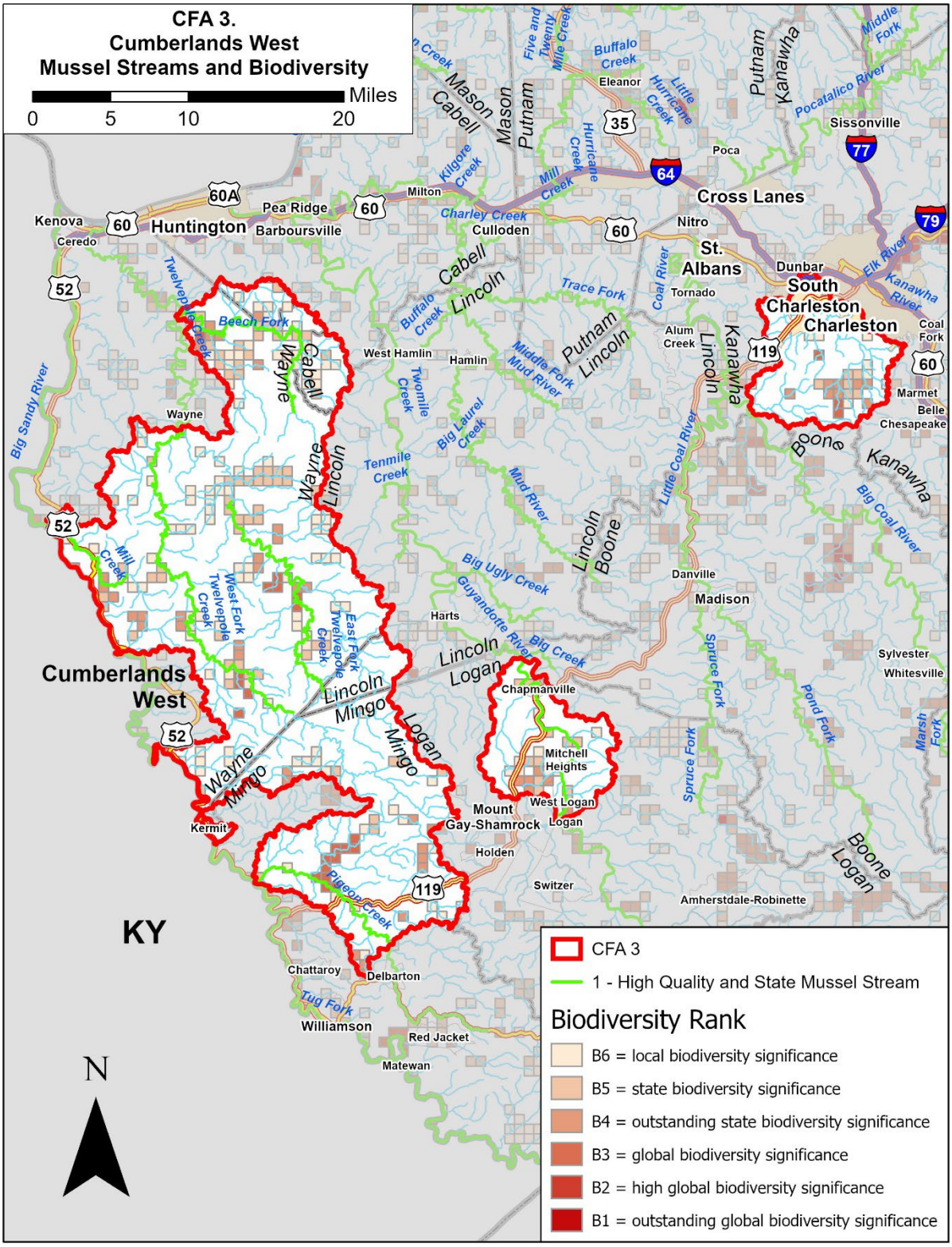
Taxa	Scientific Name	Common Name
Butterflies and Moths	Speyeria diana	Diana Fritillary
Dragonflies and Damselflies	Anax longipes	Comet Darner
Dragonflies and Damselflies	Dromogomphus spoliatus	Flag-tailed Spinyleg
Dragonflies and Damselflies	Enallagma antennatum	Rainbow Bluet
Dragonflies and Damselflies	Progomphus obscurus	Common Sanddragon
Mammals	Corynorhinus rafinesquii	Eastern Big-eared Bat
Plants	Cleistes bifaria	Small Rosebud Orchid
Plants	Trichomanes boschianum	Appalachian Bristle Fern

Map 9 illustrates riparian and floodplain habitats, and 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 listed above and are priority habitats. The B-Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats. River floodplain habitats occur along the West and East Forks of Twelvepole Creek and Beech Fork in the western most unit of the CFA, and along Guyandotte River in the central unit, which are also recognized as high quality mussel streams. Small stream riparian habitats occur along numerous smaller streams throughout the area. Aquatic and riparian habitats outside of larger forest patches may be more vulnerable to stresses.

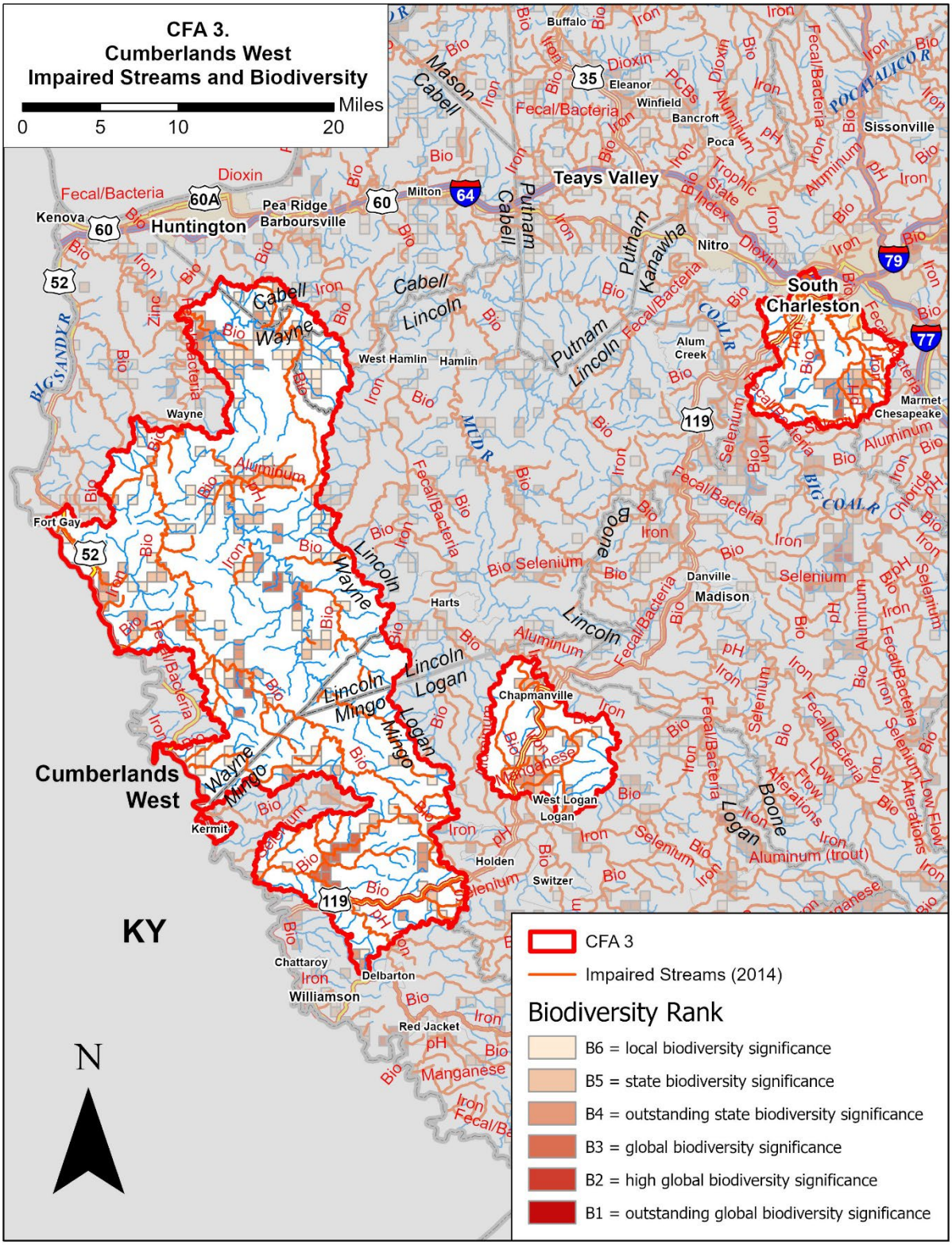
Map 9. Riparian and Floodplain Habitats



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 introduction of predacious fish into ponds for the Comet Darner, and invasive crayfish competing with the native Coalfields Crayfish. Reducing use and release of nonnative crayfish and other organisms as live bait would reduce those stresses.

Map 11 shows stream impairments, along with biodiversity. Many streams within the CFA suffer from some form of impairment, the most common of which being bio and iron. The most heavily impaired streams include Buffalo Creek, Camp Creek, Godby Branch, and the left and right forks of Camp Creek, all of which suffer from at least four known impairments (WVDEP, 2016). A table listing all impaired streams and their causes can be found in appendix 4. Many of these 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.

Table 15. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat

Habitat Stress	**Conservation Action**
Lack of protected floodplain, wetland, riparian, sandy stream and riverbanks, and upland stream valley habitat	Habitat protection through land use planning, conservation easements and other programs and activities
Water pollution and sedimentation from mining, energy infrastructure, residential development and ATV recreation	Pollution control, improved sewage treatment, storm water management, implement forestry BMPs, sediment load reductions, mine reclamation; Establish guidelines for ATV parks and trail systems to protect aquatic habitats
Stream channel degradation, channelization, dredging	Restoration of in-stream habitats and stream/floodplain interactions
Invasive plants	Monitor and treat invasive plants
Riparian habitat deforestation and disturbance	Restore, protect and maintain forested floodplains and riparian corridors, including ponds
Aquatic passage barriers	Modify or remove barriers
Flooding rare plants at maximum reservoir pool height (East Lynn Lake WMA)	Avoid maximum pool height

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 16 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 16. Climate Stresses and Resilience Actions in Aquatic, Floodplain and 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 17. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition • Natural Area designation on State Lands	• County Farmland Protection Boards • WV Land Trust • The Nature Conservancy • The Conservation Fund • USDA NRCS • WVDNR	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • 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
In-stream and riparian habitat restoration	• USDA NRCS • USDA FSA • Trout Unlimited • USFWS Partners for Fish and Wildlife • Public Land Managers • Mitigation providers: WVDEP In-Lieu Fee Stream & Wetland Mitigation program, mitigation banks and others	• 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	• USDA NRCS • USDA FSA • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOF • WVDEP and WVCA	• 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
Remove or enlarge aquatic passage barriers	• Trout Unlimited • USFWS Partners for Fish and Wildlife	• # barriers enlarged or removed • # miles stream opened • Before and after comparison: abundance and diversity of priority species
Improved wastewater and stormwater treatment	• WVDEP • WVDHHR • County governments	• # 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	• WVDEP and WVCA • USDA NRCS • USDA FSA • USDOI OSMRE	• Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Monitor and treat invasive plants in streams and wetlands	• USDA NRCS • USDA FSA • USFWS Partners for Fish and Wildlife • Dow Chemical/Ward Hollow Wildlife Habitat	• Acres treated • Treatment success rate • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Avoid maximum pool height flooding rare plants at East Lynn Lake WMA	• Public Land Managers • WVDNR • Army Corps of Engineers	• Acres of habitat protected • Change in abundance of priority species

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.

Agricultural, Anthropogenic and Developed Habitats

The Cumberlands West CFA has only

Priority Species

The following is a list of priority SGCN in the CFA associated with agricultural habitats.

Table 18. Priority Species in Agricultural, Anthropogenic and Developed Habitats

TAXA	SCIENTIFIC NAME	COMMON NAME
Birds	Spizella pusilla	Field Sparrow
Butterflies and Moths	Celastrina nigra	Dusky Azure
Butterflies and Moths	Speyeria diana	Diana Fritillary

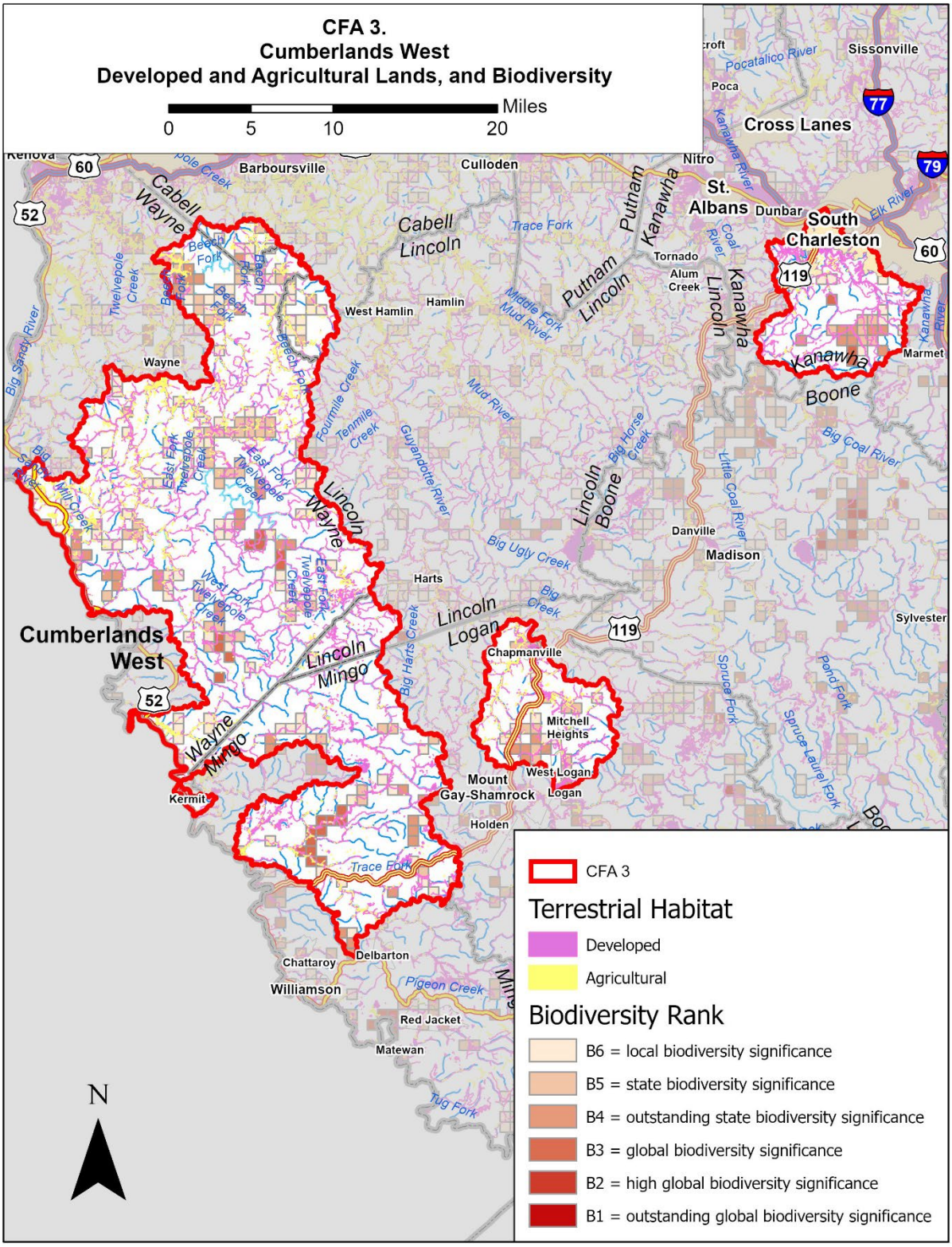
Habitat Stresses and Conservation Actions

Clearing and succession of early successional forests in anthropogenic habitats is the main stress on field sparrows.

Table 19. Habitat Stresses and Conservation Actions in Agricultural, Anthropogenic and Developed Habitats:

Habitat Stress	Conservation Action
Loss of early successional habitat in and around agricultural land and anthropogenic shrubland and grassland	Retain early successional habitat
Mowing of nectar resources	Mine reclamation with Forest Reclamation Approach and work with WVDOH and others to maintain roadside nectar resources

Map 12. Developed, Agricultural, and Anthropogenic Lands, and Biodiversity



Climate Change and Habitat Resilience

Priority SGCN associated with agricultural and anthropogenic habitats in this CFA rely on early successional forest habitat around farms and on restored and recovering mined lands. These areas may already be degraded and sensitive to disturbance. As we have seen in previous sections of this plan, these areas may also be susceptible to impacts from climate change. According to Adaptation Resources for Agriculture (Janowiak et. al, 2016), agriculture will likely be impacted by many of the same climate changes that affect forest and freshwater habitats. Likely changes include increasing temperatures, longer growing seasons, increasing number of hot days and nights, and changing precipitation patterns. Impacts include increases in the risk of damage to soil, crops, and infrastructure from extreme storm and precipitation events, flood damage, soil moisture stress and drought, competition from weeds and invasive plants, crop damage from insects and pathogens, and livestock parasites and pathogens. Butler et. al (2015) also noted that impervious surfaces in developed areas can exacerbate many of these impacts.

Janowiak et. al (2016) list numerous strategies to boost the resilience of agriculture to climate change, including maintaining soil health and water quality, reducing competition from weeds and invasive species, creating pollinator habitat, adapting farm infrastructure such as stream crossings to higher peak flows, adapting farm practices or shifting agricultural land use to match changing conditions. Managing farms as part of a larger landscape by maintaining, restoring and connecting natural habitats such as early successional forest can boost the resilience of farms by buffering hydrological impacts while providing habitat and corridors wildlife to persist and adapt to climate change. In developed areas, limiting and buffering impervious surfaces, and using constructed wetlands and other green infrastructure can also reduce the hydrological impacts of climate change.

Table 20 provides a summary of climate stresses on wildlife habitat in agricultural and developed areas, and actions to boost their resilience. Climate stresses are listed separately, but agricultural habitats are often impacted by multiple climate stresses occurring simultaneously. Therefore, actions to boost habitat resilience are intended to address multiple climate stresses. These actions reinforce conservation actions to reduce stress on priority species in agricultural and developed habitats. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Table 20. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

Climate Stress:	Habitat Resilience Action:
• 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	• Maintain soil health and water quality • Reduce competition from weeds and invasive species • Create pollinator habitat • Maintain, restore, and connect aquatic, riparian and forest habitats to buffer against hydrological impacts • Adapt farm practices, infrastructure and land uses to changing conditions • Reduce and buffer impervious surfaces, and use green infrastructure to absorb runoff and mitigate hydrological impacts

Implementation Plan

WVDNR will seek to engage the following partners and programs in implementing and measuring the effectiveness of conservation actions in agricultural habitats.

Table 21. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements	• County Farmland Protection Boards • WV Land Trust • The Nature Conservancy • USDA NRCS	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Incentive Programs	• USDA FSA	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Provide pollinator habitat through mine reclamation using Forest Reclamation Approach with native wildflowers, and work with WV DOH and others to maintain roadside wildflowers and nectar resources.	• WVDOH • WVDEP DMR • USDOI OSMRE • Public Land Managers • Mine companies	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species

Action	Partners	Effectiveness Measures
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants	• USDA FSA • USDA NRCS	• Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Maintain or restore aquatic, riparian and forest habitat as well as species and structural diversity in natural areas in and around farmland, and enhance connections between them	• USDA FSA • USDA NRCS • Public Land Managers	• Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Create early successional habitat	• USDA NRCS • Public Land Managers	• Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats
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
Adapt farm practices, infrastructure and land uses to changing conditions	• USDA FSA • USDA NRCS • Public Land Managers	• # practices or acres adapted • Change in abundance, diversity, and distribution of priority species
Create early successional forest on legacy mine lands using Forestry Reclamation Approach	• WVDEP DMR • USDOI OSMRE	• Acres reforested • Change in abundance, diversity, and distribution of priority species

Human Benefits

Actions to restore and protect wildlife habitat within agricultural areas and developed lands may provide benefits for human health and economies in surrounding communities. Benefits may include erosion control and improved water quality, improved hunting, fishing and recreational opportunities, and conservation of native pollinators for crop production.

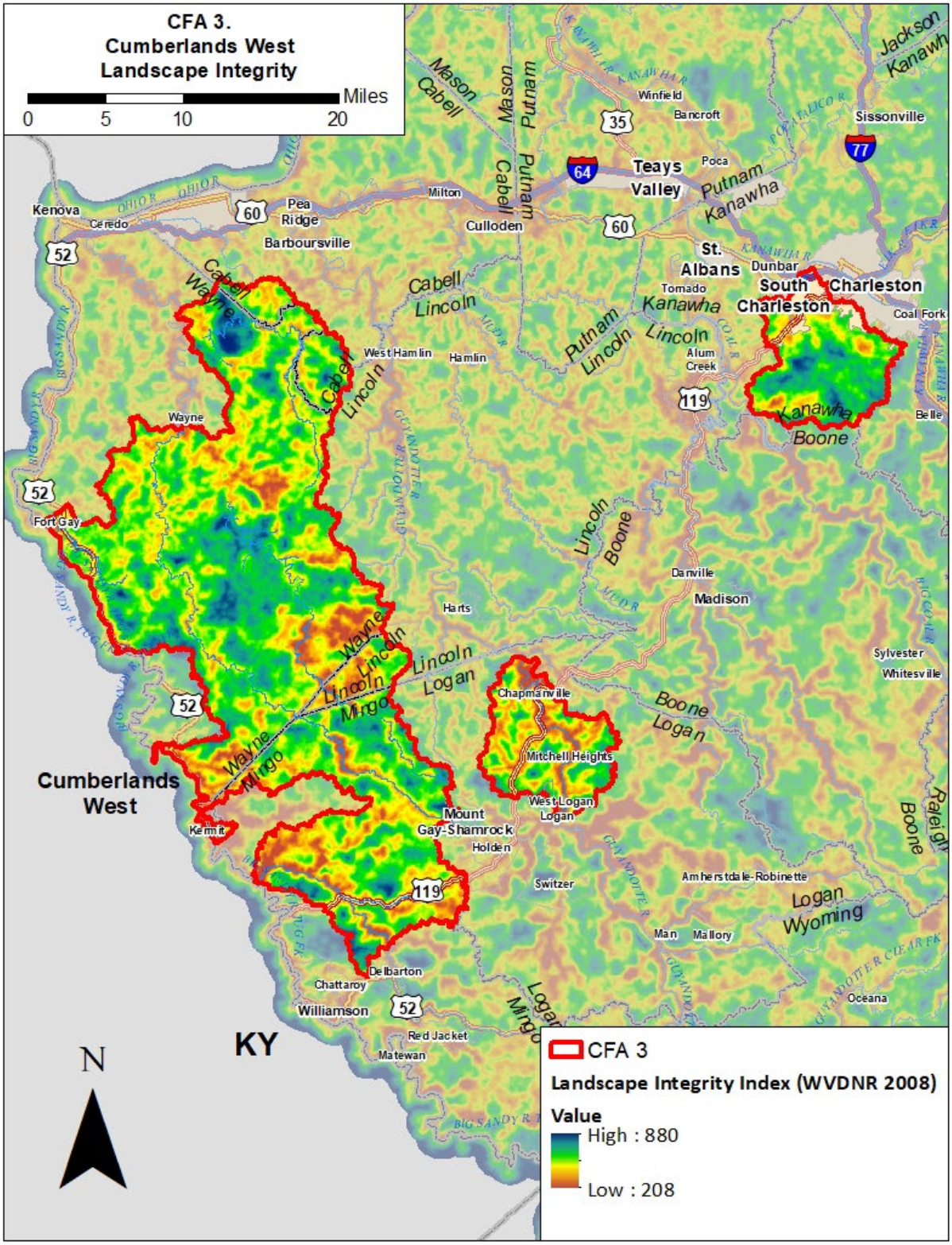
Landscape Resilience and Connectivity

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 13 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 and most lie within public lands such as State Forests and Wildlife Management Areas. 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 13. 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.

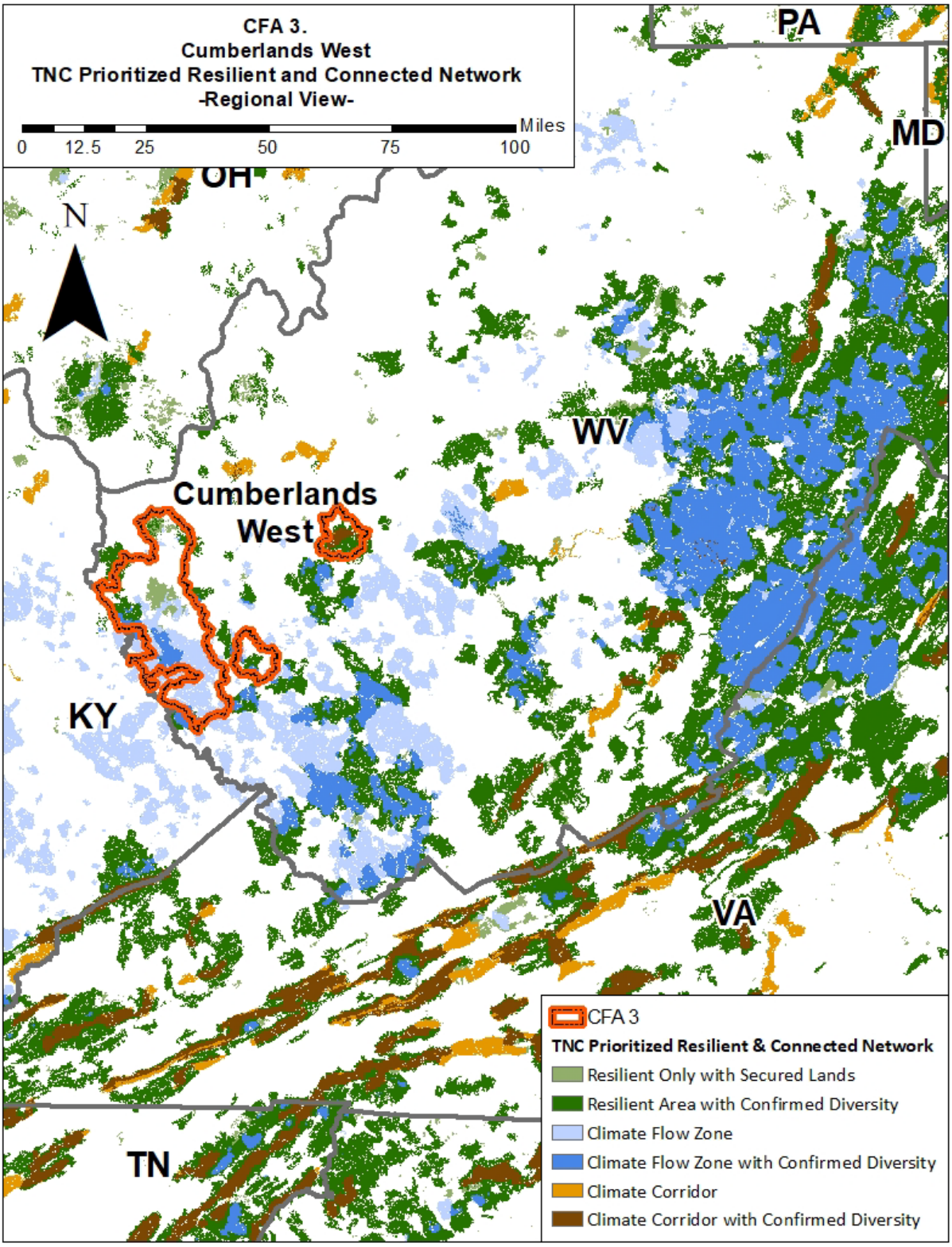
Next, the team developed models that integrated landscape resilience, connectivity and the flow of species across the landscape. They selected a connected network of sites that represents the full suite of geophysical settings, includes known records of biological diversity, and has the configuration 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:

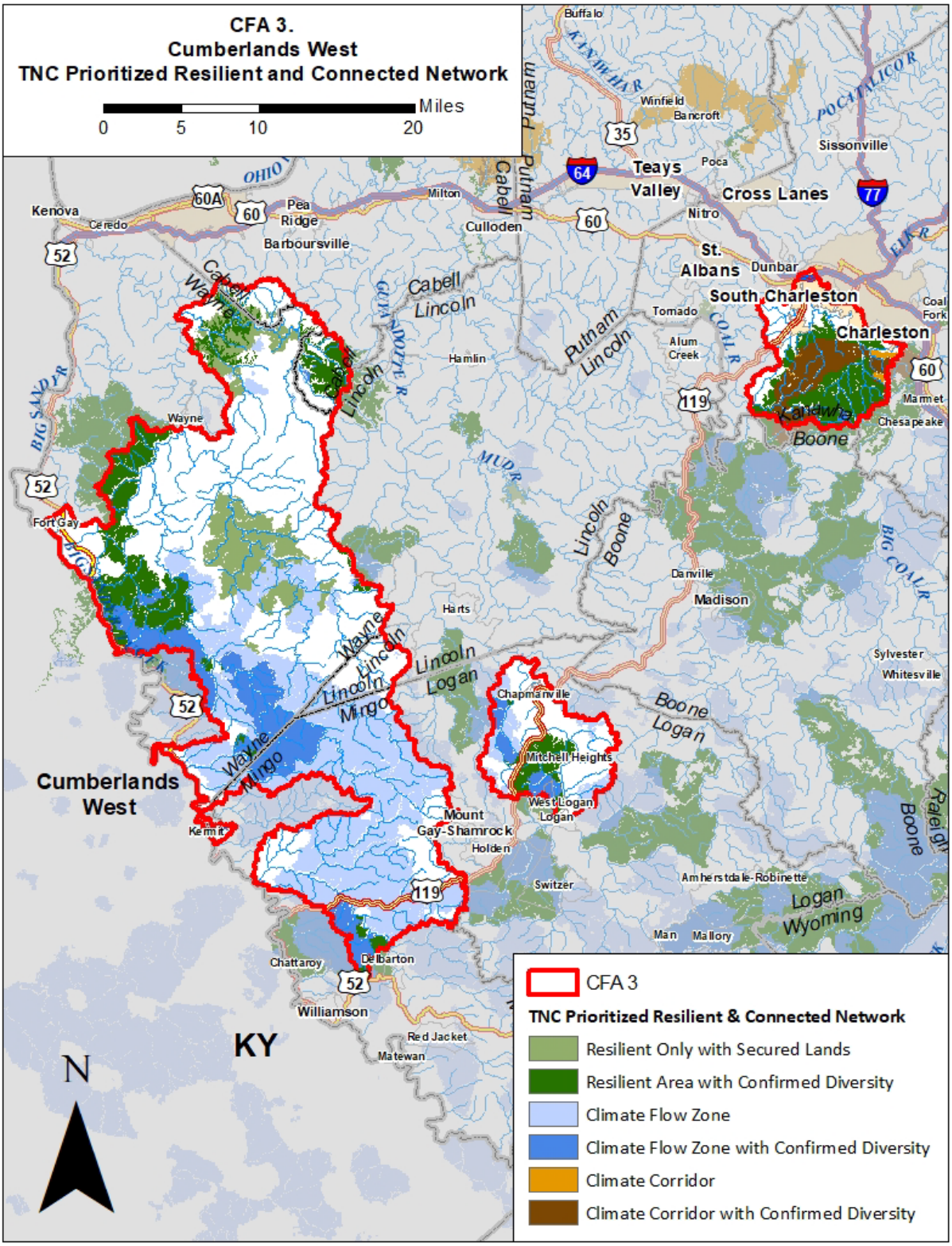
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes 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 14 illustrates that the climate flow zones and resilient areas within this CFA are part of the large hub of resilient landscapes on the southern side of the state. They are loosely connected to the larger hub of resilient, connected landscapes in the eastern portions the state and stretching along the Appalachians. The resilient, connected landscapes in this CFA are part of a connected network that is critical to species adapting to climate change across the Eastern United States.

Map 14. Priority Resilient and Connected Network – Regional View



Map 15. Priority Resilient and Connected Network – Detailed View



Map 15 provides a detailed view of the resilient and connected landscapes in the Cumberlands West CFA. The southern portion of the CFA is composed mostly of large blocks of climate flow zones with smaller blocks of resilient lands in the northern portions. These priority resilient and connected landscapes contain many of the CFA's large forest patches and high integrity areas, most of the CFA's rock outcrop, cliff and talus habitats, 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.

The table below summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Table 21. 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. The following implementation plan lists specific actions to protect, maintain and restore the network of resilient, connected lands within the CFA.

Table 22. Implementation Plan for Landscape Resilience and Connectivity

Action	Partners	Effectiveness Measures
Protection of Resilient, Connected Landscapes • Conservation Easements • Land Acquisition	• County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • 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 • Incentive Programs • Forest Carbon projects • Forest Certification Programs	• USDA FSA & NRCS • Consulting Foresters • AFF, TNC • ATFS, FSC, SFI	• 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 • Conservation and Management	• AFF, AMJV, NWTF, RGS, TNC • Forest Certification Programs: ATFS, FSC, SFI • WVDNR • WVDOF • Private Landowners • Public Land Managers • Partner Organizations	• 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 targeted for conservation action on public and private land and within each major habitat type. The major habitat types include forests and woodlands, barrens, cliffs and talus, caves and karst, aquatic, riparian, floodplain, developed, and agricultural 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, including in and around agricultural areas and anthropogenic shrublands and grasslands
- Acidic rock outcrops, cliffs and talus
- Small stream riparian and river floodplain habitats, and high quality mussel streams
- Riparian corridors, wetlands, grasslands and fallow fields, field borders and other areas of natural and woody vegetation within and around agricultural, anthropogenic and developed 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 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 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 rock outcrops, cliff and talus 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, reclaimed mine lands, 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 even beyond 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 Cumberlands West CFA

Taxa	Scientific Name	Common Name	S RANK	G RANK
Amphibians	Aneides aeneus	Green Salamander	S3	G3G4
Amphibians	Pseudotriton ruber ruber	(northern) Red Salamander	S3	G5
Amphibians	Gyrinophilus porphyriticus duryi	Kentucky Spring Salamander	S3	G5T4T5
Amphibians	Pseudotriton montanus diastictus	Midland Mud Salamander	S1	G5T5
Amphibians	Scaphiopus holbrookii	Eastern Spadefoot	S1	G5
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3G4
Amphibians	Desmognathus welteri	Black Mountain Salamander	S2	G4
Amphibians	Necturus maculosus	Mudpuppy	S4	G5
Amphibians	Ambystoma jeffersonianum	Jefferson Salamander	S2	G4
Amphibians	Plethodon kentucki	Cumberland Plateau Salamander	S3	G4
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5
Birds	Butorides virescens	Green Heron	S3B	G5
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5
Birds	Petrochelidon pyrrhonota	Cliff Swallow	S3B	G5
Birds	Catharus fuscescens	Veery	S3B	G5
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5
Birds	Setophaga discolor	Prairie Warbler	S3B	G5
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4
Birds	Anas rubripes	American Black Duck	S2B,S2N	G5
Birds	Spizella pusilla	Field Sparrow	S3B	G5
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5
Birds	Colinus virginianus	Northern Bobwhite	S1B, S1N	G5

Taxa	Scientific Name	Common Name	S RANK	G RANK
Birds	Limnothlypis swainsonii	Swainson's Warbler	S3B	G4
Birds	Podilymbus podiceps	Pied-billed Grebe	S2B,S4N	G5
Birds	Actitis macularius	Spotted Sandpiper	S2B	G5
Birds	Piranga rubra	Summer Tanager	S3B	G5
Birds	Falco sparverius	American Kestrel	S3B	G5
Birds	Spiza americana	Dickcissel	S1B	G5
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5
Birds	Chaetura pelagica	Chimney Swift	S3B	G5
Butterflies and Moths	Pieris virginiensis	West Virginia White	S3	G3?
Butterflies and Moths	Calycopis cecrops	Red-banded Hairstreak	S3	G5
Butterflies and Moths	Celastrina nigra	Dusky Azure	S3	G4
Butterflies and Moths	Glaucopsyche l. lygdamus	Silvery Blue	S4	G5T3T4
Butterflies and Moths	Hadena ectypa	Starry Campion Moth	S1	G3G4
Butterflies and Moths	Speyeria diana	Diana Fritillary	S2S3	G3G4
Butterflies and Moths	Satyrium caryaevorus	Hickory Hairstreak	S2	G4
Crayfish	Cambarus theepiensis	Coalfields Crayfish	S3	GNR
Crayfish	Cambarus hatfieldi	Tug Fork Valley Crayfish	S2	G2G3?
Dragonflies and Damselflies	Anax longipes	Comet Darner	S3	G5
Dragonflies and Damselflies	Macromia illinoiensis	Illinois River Cruiser	S3	G5
Dragonflies and Damselflies	Tachopteryx thoreyi	Gray Petaltail	S3	G4
Dragonflies and Damselflies	Dromogomphus spoliatus	Flag-tailed Spinyleg	SH	G4G5
Dragonflies and Damselflies	Enallagma antennatum	Rainbow Bluet	S1S2	G5
Dragonflies and Damselflies	Progomphus obscurus	Common Sanddragon	S2S3	G5
Dragonflies and Damselflies	Tramea onusta	Red Saddlebags	S1	G5
Dragonflies and Damselflies	Tramea carolina	Carolina Saddlebags	S3	G5
Dragonflies and Damselflies	Gomphus viridifrons	Green-faced Clubtail	S3	G3G4
Fish	Macrhybopsis hyostoma	Shoal Chub	S2	G5
Fish	Carpiodes carpio	River Carpsucker	S3	G5
Fish	Pimephales vigilax	Bullhead Minnow	S2	G5

Taxa	Scientific Name	Common Name	S RANK	G RANK
Fish	Chrosomus erythrogaster	Southern Redbelly Dace	S2S3	G5
Fish	Carpiodes velifer	Highfin Carpsucker	S1	G4G5
Fish	Phenacobius mirabilis	Suckermouth Minnow	S3	G5
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4
Fish	Lethenteron appendix	American Brook Lamprey	S2	G4
Fish	Ammocrypta pellucida	Eastern Sand Darter	S3	G3
Fish	Noturus eleutherus	Mountain Madtom	S2	G4
Fish	Ameiurus melas	Black Bullhead	S1	G5
Fish	Polyodon spathula	Paddlefish	S1	G4
Fish	Percina evides	Gilt Darter	S2	G4
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5
Fish	Percina copelandi	Channel Darter	S2S3	G4
Fish	Lepomis gulosus	Warmouth	S1	G5
Fish	Cottus sp. 1	Bluestone Sculpin	S1	G2
Fish	Moxostoma carinatum	River Redhorse	S3	G4
Fish	Ichthyomyzon unicuspis	Silver Lamprey	S2S3	G5
Fish	Macrhybopsis storeriana	Silver Chub	S3	G5
Fish	Percina sciera	Dusky Darter	S3	G5
Fish	Ichthyomyzon bdellium	Ohio Lamprey	S2S3	G3G4
Mammals	Synaptomys cooperi	Southern Bog Lemming	S3	G5
Mammals	Myotis leibii	Eastern Small-footed Bat	S1	G3
Mammals	Microtus ochrogaster	Prairie Vole	S3	G5
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2G3
Mammals	Myotis sodalis	Indiana Bat	S1	G2
Mammals	Neotoma magister	Allegheny Woodrat	S3	G3G4
Mammals	Corynorhinus rafinesquii	Eastern Big-eared Bat	S1	G3G4
Mammals	Perimyotis subflavus	Tricolored Bat	S2*	G3
Mammals	Lasiurus borealis	Eastern Red Bat	S4	G5
Mussels	Lampsilis cardium	Plain Pocketbook	S3	G5
Mussels	Lasmigona complanata	White Heelsplitter	S3	G5

Taxa	Scientific Name	Common Name	S RANK	G RANK
Mussels	Lasmigona costata	Fluted-shell	S3	G5
Mussels	Obovaria subrotunda	Round Hickorynut	S3	G4
Mussels	Toxolasma parvus	Lilliput	S2	G5
Mussels	Truncilla truncata	Deertoe	S2	G5
Mussels	Leptodea fragilis	Fragile Papershell	S3	G5
Mussels	Pyganodon grandis	Giant Floater	S3	G5
Mussels	Fusconaia subrotunda	Long-solid	S3	G3
Mussels	Tritogonia verrucosa	Pistolgrip	S3	G4G5
Mussels	Fusconaia flava	Wabash Pigtoe	S1	G5
Mussels	Strophitus undulatus	Squawfoot	S3	G5
Mussels	Amblema plicata	Threeridge	S3	G5
Mussels	Quadrula quadrula	Mapleleaf	S3	G5
Mussels	Elliptio crassidens	Elephant-ear	S2	G5
Mussels	Actinonaias ligamentina	Mucket	S3	G5
Mussels	Utterbackia imbecillis	Paper Pondshell	S2	G5
Other Invertebrates	Alloperla aracoma	A Stonefly	S1	G3
Other Invertebrates	Hansonoperla hokolesqua	A Stonefly	S1	G2
Plants	Juglans cinerea	Butternut	S3	G4
Plants	Croton glandulosus var. septentrionalis	Vente-conmigo	S3	G5T5
Plants	Ranunculus pusillus var. pusillus	Low Spearwort	S1	G5T4?
Plants	Ribes hirtellum	Hairy-stem Gooseberry	S1	G5
Plants	Heuchera longiflora	Long-flower Alumroot	S2	G4
Plants	Viola tripartita	Three-parted Yellow Violet	S1	G5
Plants	Trillium flexipes	Nodding Wakerobin	S2	G5
Plants	Quercus shumardii	Shumard Oak	S2	G5
Plants	Ranunculus pensylvanicus	Bristly Crowfoot	S1	G5
Plants	Desmodium pauciflorum	Few-flower Tick-trefoil	S1	G5
Plants	Woodwardia areolata	Netted Chainfern	S2	G5
Plants	Carex planispicata	Flat-spiked Sedge	S2	G4Q
Plants	Cyperus refractus	Reflexed Flatsedge	S3	G5

Taxa	Scientific Name	Common Name	S RANK	G RANK
Plants	Triadenum tubulosum	Lesser Marsh-st. John's-wort	S1	G4?
Plants	Synandra hispidula	Guyandotte Beauty	S1	G4
Plants	Carex typhina	Cattail Sedge	S2	G5
Plants	Scutellaria ovata ssp. ovata	Heart-leaved Skullcap	S1	G5T5
Plants	Cleistes bifaria	Small Rosebud Orchid	S1	G4?
Plants	Cuscuta indecora var. neuropetala	Dodder	S1	G5T5
Plants	Melothria pendula var. pendula	Creeping Cucumber, Guadeloupe Cucumber	S1	G5?
Plants	Calycanthus floridus var. glaucus	Carolina Allspice, Strawberry-shrub	SH	G5T5
Plants	Ageratina aromatica var. aromatica	Small White Snakeroot	S1	G5T5
Plants	Rosa acicularis ssp. sayi	Bristly Rose	S1	G5T5
Plants	Corallorhiza wisteriana	Wister's Coralroot, Spring Coralroot	S2	G5
Plants	Silene rotundifolia	Sandstone Fire-pink	S1	G4
Plants	Rudbeckia fulgida var. fulgida	Orange Coneflower	S2	G5T4?
Plants	Luzula bulbosa	Bulbous Woodrush	S1	G5
Plants	Arundinaria gigantea ssp. gigantea	Giant Cane	S2	G5T5?
Plants	Monotropsis odorata	Sweet Pinesap	S1	G3
Plants	Carex hirtifolia	Pubescent Sedge	S3	G5
Plants	Carex mesochorea	Midland Sedge	S2	G4G5
Plants	Asplenium bradleyi	Bradley's Spleenwort	S1	G4
Plants	Prenanthes crepidinea	Corymbed Rattlesnake-root	S1	G4
Plants	Anemone quinquefolia var. minima	Dwarf Anemone	S2	G5T3
Plants	Melica mutica	Two-flower Melicgrass	S2	G5
Plants	Hexalectris spicata var. spicata	Spiked Crested Coralroot	S1	G5T4T5
Plants	Trichomanes boschianum	Appalachian Bristle Fern	S1	G4
Plants	Carex aggregata	Glomerate Sedge	S2	G5
Plants	Lygodium palmatum	American Climbing Fern	S3	G4
Plants	Manfreda virginica	Eastern Agave	S1	G5
Plants	Polygala curtissii	Curtiss' Milkwort	S2	G5
Plants	Sida hermaphrodita	Virginia Mallow	S3	G3

Taxa	Scientific Name	Common Name	S RANK	G RANK
Plants	Scleria triglomerata	Whip Nutrush	S2	G5
Plants	Scleria oligantha	Little-head Nutrush	S1	G5
Plants	Ampelopsis cordata	Heartleaf Peppervine	S1	G5
Plants	Carex laxiculmis var. copulata	Spreading Sedge	S2	G5T3T5
Plants	Lysimachia tonsa	Southern Loosestrife	SH	G4
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	G5T5
Reptiles	Carphophis amoenus	Wormsnake	S3	G5
Reptiles	Pseudemys rubriventris	Northern Red-bellied Cooter	S2	G5
Reptiles	Thamnophis sauritus	Eastern Ribbonsnake	S2	G5
Reptiles	Agkistrodon contortrix mokasen	Northern Copperhead	S5	G5T5
Reptiles	Opheodrys aestivus	Rough Greensnake	S2	G5
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4
Reptiles	Virginia valeriae valeriae	Eastern Earthsnake	S2	G5T5
Reptiles	Apalone spinifera spinifera	Eastern Spiny Softshell	S4	G5T5
Reptiles	Regina septemvittata	Queen Snake	S4	G5
Reptiles	Plestiodon anthracinus anthracinus	Northern Coal Skink	S2	G5T5
Reptiles	Coluber constrictor constrictor	Northern Black Racer	SNR	G5T5
Reptiles	Heterodon platirhinos	Eastern Hog-nosed Snake	S2	G5
Reptiles	Plestiodon laticeps	Broad-headed Skink	S2	G5
Reptiles	Scincella lateralis	Little Brown Skink	S2	G5
Reptiles	Lampropeltis getula	Eastern Kingsnake	S2	G5
Snails	Triodopsis tennesseensis	Budded Threetooth	S3	G4
Snails	Stenotrema macgregori	Fraudulent Slitmouth	S2	GNR
Snails	Vertigo tridentata	Honey Vertigo	S3	G5
Snails	Punctum smithi	Lamellate Spot	S2	G4
Snails	Striatura milium	Flat-ribbed Striate	S2	G5
Snails	Triodopsis tennesseensis	Budded Threetooth	S3	G4
Tiger Beetles	Cicindela unipunctata	A Tiger Beetle	S3	G4G5

Appendix 2. Priority SGCN, Known Stresses and Actions

Agricultural and Developed Habitats		
Common Name	**Local Stress**	**Action**
Field Sparrow	• Insufficient habitat	• Create early successional habitat
Barrens, Rock Outcrops, Cliffs and Talus Habitats		
Common Name	**Local Stress**	**Action**
Green Salamander	• Climate change. • Recreational climbing. • Loss of forested buffer surrounding outcrops	• Maintain and protect forested buffer surround all rocky outcrops. limit recreational use
Timber Rattlesnake	• Persecution. • Collection. • Habitat destruction	• Increased surveillance around susceptible den sites. • Forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus, and rocky outcrops
Sandstone Fire-pink	• Trampling around rock outcrops	• Monitor populations.
Appalachian Bristle Fern	• Flooding at maximum reservoir pool height	• Avoid maximum pool height.
Forest and Woodland Habitats		
Common Name	**Local Stress**	**Action**
Green Salamander	• Climate change. • Recreational climbing. • Loss of forested buffer surrounding outcrops	• Maintain and protect forested buffer surround all rocky outcrops. limit recreational use

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
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
Swainson's Warbler	• Riparian habitat loss and degradation	• Research to assess productivity and survival in novel breeding habitat dominated by invasive species. • Protect floodplain forests with suitable habitat
Summer Tanager	• Habitat loss and degradation	• Manage forests for interior gaps and edges
Cerulean Warbler	• Poor forest structure	• Manage forests to create suitable habitat as per CERW guidelines
Prairie Warbler	• Forest maturation. • Herbicide use/veg mgmt in utility corridors	• Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat

Blue-winged Warbler	• Insufficient habitat. Residential development	• Reduce clean farming practices. • Create early successional habitat
Dusky Azure	• MTR mining. Excessive mowing that removes nectar resources. Unregulated ATV recreation	• Mine reclamation with FRA approach including native wildflowers where possible. • Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
West Virginia White	• Expansion of invasive garlic mustard	• Pull garlic mustard. • Education for landowners about garlic mustard
Hickory Hairstreak	• Unknown - possibly removal of hickories (Carya) from forests	• Additional effort in locating populations
Diana Fritillary	• MTR mining. • Excessive mowing that removes nectar resources. • Unregulated ATV recreation	• Mine reclamation with FRA approach including native wildflowers where possible. • Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
Eastern Big-eared Bat	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Creeping Cucumber, Guadeloupe Cucumber	• Road maintenance. • Unknown status	• Do not spray herbicides or mow. • Survey for additional populations
Sweet Pinesap	• Unknown status	• Field survey to determine species distribution and threats.

Timber Rattlesnake	• Persecution. Collection. Habitat destruction	• Increased surveillance around susceptible den sites. • Forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus, and rocky outcrops
Eastern Box Turtle	• Collection. Disease. Road Mortality. Habitat destruction. Artifical increase in mesocarnivores	• Reduce illegal collection. Educate land managers, biologists, and researchers about appopriate 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
Bradley's Spleenwort	• Collecting. • Small populations	• Do not publicize occurrence in State Forest.
Aquatic Habitats		
Common Name	**Local Stress**	**Action**
Coalfields Crayfish	• Introduced/invasive crayfish. • Siltation. • Stream degradation	• Restore channelized streams. • Bait regulations to limit spread of exotic crayfish. • Reduce non-point source pollution
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, ATV traffic etc.)
Redside Dace	• Increasing stream temperatures. • Increased stream sedimentation	• Restore riparian areas. • Mitigate causes of sedimentation. • BMPs by resourse extraction companies

Bluestone Sculpin	• Increasing stream temperatures. • Increased stream sedimentation.	• Restore riparian area. • Mitigate causes of sedimentation. • Ban live bait use
American Brook Lamprey	• Increased sedimentation. • Stream passage barriers	• Riparian restoration
Mountain Madtom	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration, municipal water treatment for small towns,
Suckermouth Minnow	• Increased sedimentation. • Increased stream temperatures	• Riparian restoration
A Stonefly	• Agriculture, logging, impoundments	• Restore or create habitat where extirpated. • Benthic species data collection
Floodplain, Riparian, Pond and Wetland Habitats		
Common Name	**Local Stress**	**Action**
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 novel 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

Dusky Azure	• MTR mining. • Excessive mowing that removes nectar resources. • Unregulated ATV recreation	• Mine reclamation with FRA approach including native wildflowers where possible. • Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
Diana Fritillary	• MTR mining. Mowing of nectar resources. development	• Mine reclamation with FRA approach including native wildflowers where possible. • Support dialog with WVDOH and others to maintain nectar resources along roads and in other areas
Flag-tailed Spinyleg	• Loss of good water quality	• Improve municipal/household wastewater systems. • Surveys to determine population status
Common Sanddragon	• Development of stream and riverbanks. • Sand dredging	• Maintain sandy stream and riverbanks
Comet Darner	• Introduction of predaceous fish into ponds. • Lack of cover in ponds	• Educate sportsmen to not release fish into ponds
Rainbow Bluet	• Poor water quality of streams. • Loss of stream side vegetation	• Improve municipal/household wastewater systems. • Surveys to determine population status
Eastern Big-eared Bat	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.

Small Rosebud Orchid	• Woody encroachment	• Consider prescribed burning. • Conduct field surveys to determine species distribution and threats.
Caves and Karst Habitats		
Common Name	**Local Stress**	**Action**
Eastern Big-eared Bat	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Reduce nonpoint pollution sources • Restore riparian corridors

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat

Beech Fork Lake Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **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, Warm
		• Small River, Low Gradient, Warm

Chief Logan Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Aquatic, Floodplain, and Riparian**
	  • Open Water
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, High Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

East Lynn Lake 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, and Shale Barrens**
	  • 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, Warm
		• Small River, Low Gradient, Warm
		• Small River, Moderate Gradient, Warm
		• Small River, High Gradient, Warm

Laurel Lake 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, and Shale Barrens**
	  • Acidic Rock Outcrops, Cliffs, and Talus
	• **Aquatic, Floodplain, and Riparian**
	  • Open Water
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Low Gradient, Warm
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

Tomblin 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, and Shale Barrens**
	  • Acidic Rock Outcrops, Cliffs, and Talus
	• **Aquatic, Floodplain, and Riparian**
	  • Open Water
	  • River Floodplains
	  • Small Streams Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Warm
		• Small River, Low Gradient, Warm
		• Small River, Moderate Gradient, Warm

Cabwaylingo State Forest	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Rock Outcrops, Cliffs and Talus, and Shale Barrens**
	  • Acidic Rock Outcrops, Cliffs, and Talus
	• **Aquatic, Floodplain, and Riparian**
	  • 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, Warm
		• Small River, Low Gradient, Warm
		• Small River Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

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

Beech Fork State Park	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **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, Warm
		• Small River, Low Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

Chief Logan State Park	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Rock Outcrops, Cliffs and Talus, and Shale Barrens**
	  • 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, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Warm

Appendix 4. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05090102000104	WVO-2-H_02	BeechFork	Bio
05090102000096	WVO-2-H_01	BeechFork	Bio
05090102001894	WVO-2-H-(L1)_00	BeechForkLake	Phosphorus
05070201000568	WVBST-24-B_02	BigBranch	Selenium
05070201000568	WVBST-24-B_01	BigBranch	Selenium
05090102000191	WVO-2-P-1_00	BigBranch	Bio
05070102000414	WVOG-49_00	BigCreek	Aluminum
05090102000186	WVO-2-P-12_00	BillyBranch	Bio
05090102001650	WVO-2-P-36_01	BreedenCreek	Bio
05090102001667	WVO-2-P-36_02	BreedenCreek	Bio, Iron
05050009000242	WVKC-13_00	BrierCreek	Bio, Fecal
05070102000439	WVOG-61_00	BuffaloCreek	pH, Aluminum, Iron, Manganese
05090102000380	WVO-2-H-8_00	ButlerBranch	Bio
05090102000244	WVO-2-Q-8_00	CampCreek	Bio, pH, Aluminum, Iron
05050008000778	WVK-39-L_00	CaneFork	Bio, Fecal, Iron
05050008000782	WVK-39-J_00	CoalHollow	Bio, Fecal, Iron
05090102001621	WVO-2-Q-18-G_01	CopleyTraceBranch	Bio, Selenium
05090102001361	WVO-2-Q-18-G_02	CopleyTraceBranch	Selenium
05090102000983	WVO-2-Q-17_00	CoveCreek	Bio
05070102000051	WVOG-51_00	CrawleyCreek	Bio, Aluminum, Iron
05050008000048	WVK-39_01	DavisCreek	Bio, Fecal, Iron
05050008000055	WVK-39_02	DavisCreek	Fecal, Iron
05050008002008	WVK-39-D_00	DryBranch	Iron
05090102000076	WVO-2-Q_04	EastFork/TwelvepoleCreek	Bio
05090102000059	WVO-2-Q_02	EastFork/TwelvepoleCreek	Bio
05070201000592	WVBST-24-N_00	ElkCreek	Bio
05070102002076	WVOG-51.5_00	FowlerBranch	Bio
05070102002100	WVOG-53_00	GodbyBranch	Bio, pH, Iron
05070102002246	WVOG-lo_03_r	GuyandotteRiver(lower)	Bio, Fecal, Iron
05050008000775	WVK-39-M-1-A_00	HoffmanHollow	pH
05090102000226	WVO-2-Q-29_01	HoneyBranch	Bio
05090102000161	WVO-2-P-29-B_00	JacksFork	Iron
05070201000495	WVBST-17_01	JennieCreek	Bio
05070201000500	WVBST-17_03	JennieCreek	Bio
05070201000498	WVBST-17_02	JennieCreek	Bio, Iron
05090102001628	WVO-2-Q-18-H_01	JimsBranch	Bio
05050008000770	WVK-39-M_01	KanawhaFork	Bio, Fecal, Iron
05050008000771	WVK-39-M_02	KanawhaFork	Bio, Fecal, pH, Aluminum, Iron
05090102000084	WVO-2-Q-18_01	KiahCreek	Bio
05050008002020	WVK-39-I_00	KirbyHollow	Iron
05070201001392	WVBST-24-E_00	LaurelFork/PigeonCreek	Bio
05090102000247	WVO-2-Q-8-A_00	LeftFork/CampCreek	Bio, Fecal, pH, Aluminum

Reach Code	AUID	Common Name	Impairments
05070201001245	WVBST-24-K-4-A_00	LeftFork/RightFork/TraceFork	Selenium
05090102000274	WVO-2-H-7_00	LongBranch	Bio
05050008000763	WVK-39-E-1_00	LongBranch	Iron
05070201000671	WVBST-7_00	LostCreek	Bio
05090102000194	WVO-2-Q-9_00	LynnCreek	Bio
05070201000486	WVBST-19_00	MarrowboneCreek	Bio
05090102001254	WVO-2-Q-23_01	MaynardBranch	Bio
05050008000271	WVK-39-E_00	MiddleFork/DavisCreek	Bio, Fecal, Iron
05070201004743	WVBST-24-E-2-A-1_00	MiddleFork/SpruceFork	Selenium
05050008000772	WVK-39-M-1_00	MiddlelickBranch	Iron
05070201000501	WVBST-1_00	MillCreek	Bio
05070102000431	WVOG-59_00	MillCreek	Bio
05090102000033	WVO-2-P-21_01	MosesFork	Bio
05090102000173	WVO-2-P-43_00	MosesFork	Bio
05050008000759	WVK-39-B-1_00	MudsuckBranch	Iron
05090102000167	WVO-2-P-37_02	OpenmouthBranch	Iron
05090102000209	WVO-2-Q-18-D_01	ParkerBranch	Bio
05070201000448	WVBST-24_01	PigeonCreek	Bio, pH, Iron
05050008002187	WVK-39-B-2_00	PotBranch	Iron
05070201000669	WVBST-3_00	PowdermillBranch	Bio, Iron
05050008000783	WVK-39-F_00	RaysBranch	Bio, Fecal, Iron
05090102000238	WVO-2-Q-14_00	RichCreek	Iron
05070102002195	WVOG-61-A_00	RightFork/BuffaloCreek	pH, Iron
05090102000245	WVO-2-Q-8-B_00	RightFork/CampCreek	Bio, pH, Aluminum, Iron
05070201004746	WVBST-24-E-1_01	RightFork/LaurelFork/PigeonCreek	Bio
05090102000154	WVO-2-P-21-C_00	RightFork/MosesFork	Bio
05070201001241	WVBST-24-K-4_00	RightFork/TraceFork	Selenium
05070201001298	WVBST-16_00	SilverCreek	Bio
05070201002960	WVBST-24-K-8_00	SimmonsFork	Bio
05070102000446	WVOG-51-G.5_00	SouthFork/CrawleyCreek	Bio
05070201001267	WVBST-24-E-2_00	SpruceFork	Bio
05050008002003	WVK-39-C_00	SugarcampCreek	Iron
05090102000248	WVO-2-Q-8-A-1_00	TigerFork	Fecal
05070201000644	WVBST-24-K_00	TraceFork	Bio
05090102000121	WVO-2-P-4_00	TraceFork	Bio
05050008000307	WVK-39-B_00	TraceFork	Bio, Fecal, Iron
05090102000125	WVO-2-Q-18-C_02	TroughFork	Bio
05070201000059	WVBST_02	TugFork	Bio, Fecal, Iron
05070201000059	WVBST_01	TugFork	Fecal, Iron
05090102000126	WVO-2-P-29_01	TurkeyCreek	Bio
05090102000126	WVO-2-P-29_02	TurkeyCreek	Bio, Iron
05090102000852	WVO-2-Q-8-0.5A_00	UNT/CampCreekRM0.50	pH, Aluminum
05050008000779	WVK-39-L-1_00	UNT/CaneForkRM0.83	Iron
05090102001635	WVO-2-Q-30-A_00	UNT/LaurelBranchRM0.34	Selenium
05070201002883	WVBST-24-E-7.3_00	UNT/LaurelForkRM9.61	Bio

Reach Code	AUID	Common Name	Impairments
05070201002990	WVBST-24-G_00	UNT/PigeonCreekRM6.72 (WhiteBranch)	Iron
05070102002233	WVOG-62-B_00	UNT/SnapCreekRM0.63	Iron
05070201001485	WVBST-2_01	VinsonBranch	pH
05050008001983	WVK-39-A_00	WardHollow	Fecal, Iron
05090102000152	WVO-2-P-19_00	WellsBranch	Bio
05090102000039	WVO-2-P_01	WestFork/TwelvepoleCreek	Bio
05090102000046	WVO-2-P_02.1	WestFork/TwelvepoleCreek	Bio
05090102001540	WVO-2-P_02.2	WestFork/TwelvepoleCreek	Bio, Iron

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.
Beech Fork State Park Foundation https://www.facebook.com/bfspf	• Beech Fork State Park Foundation is a 501(c)3 non-profit dedicated to the conservation and recreation of Beech Fork State Park
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
County Planning Commissions	• Planning to manage floodplains and guide new development

Partner	Role/Assistance Provided
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 State Forest Foundation https://ksff.org/	• The Kanawha State Forest Foundation is a volunteer non-profit organization created over 30 years ago with a mission to protect, promote, and preserve Kanawha State Forest.
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
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.

Partner	Role/Assistance Provided
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
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
USDA Farm Service Agency (FSA) 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

Partner	Role/Assistance Provided
	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.
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 Agriculture and Forestry Mitigation 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.

Partner	Role/Assistance Provided
USDOI 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
US DOI Office of Surface Mining Reclamation and Enforcement (OSMRE) https://www.osmre.gov/index.shtm Appalachian Regional Reforestation Initiative (ARRI) https://arri.osmre.gov/About/AboutARRI.shtm	• OSMRE is the primary regulator of coal mining under the Surface Mining Control and Reclamation Act (SMCRA) of 1977 until a State or Indian Tribe develops its own regulations to meet SMCRA and OSMRE requirements. • OSMRE partners with States to regulate mining on Federal lands and to support States' regulatory programs with grants and technical assistance • Abandoned Mine Land (AML) Reclamation Program addresses the hazards and environmental degradation posed by mines abandoned before the SMCRA • The Appalachian Regional Reforestation Initiative (ARRI) is a coalition of groups, including citizens, the coal industry, and government dedicated to restoring forests on coal mined lands in the Eastern United States
Ward Hollow Wildlife Habitat https://www.facebook.com/WardHollowWildlifeHabitat/	• 150 acre wildlife habitat in South Charleston, WV, at the Regional Technology Park.
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 • In Lieu Fee (ILF) Stream and Wetland Mitigation Program https://dep.wv.gov/wwe/programs/pages/in-lieu-fee.aspx • Division of Mining and Reclamation (DMR) https://dep.wv.gov/dmr/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	• 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 • ILF Program achieves compensatory mitigation for unavoidable impacts to waters of the United States and state waters, including wetlands, streams and associated buffers. The goal is to achieve no net loss of existing stream and wetland acreage and functions in WV through effective restoration, enhancement, replacement and preservation of aquatic resources. • DMR's mission is to assure compliance with the West Virginia Surface Mining and Reclamation Act and other applicable state laws and rules by means of effective and high quality reclamation of mining sites, an efficient permitting program, and constructive communications between the public and regulated industry. • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects
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
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
Wildlife Habitat Council https://www.wildlifehc.org/	• Wildlife Habitat Council (WHC) empowers companies to advance biodiversity, sustainability, employee engagement and community relations goals. • WHC programs translate corporate sustainability goals and objectives into tangible and measurable on-the-ground actions. Through a focus on building collaboration for conservation with corporate employees, other conservation organizations, government agencies and community members, WHC programs focus on healthy ecosystems and connected communities.

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 Capitol and Guyan Conservation Districts Summarizes natural resources conditions and resource concerns that could be addressed through technical and financial assistance from NRCS and partners. 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. http://gwwa.org/resources/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
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