

Action Plan for the Bluestone Lake & Peters Mountain Conservation Focus Area



November, 2023

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List of Acronyms Used

ACEP- Agricultural Conservation Easement Program	RGS- Roughed Grouse Society
AFF- American Forest Foundation	SFI- Sustainable Forestry Initiative
AMJV- Appalachian Mountain Joint Venture	SGCN- Species of Greatest Conservation Need
ATFS- American Tree Farm System	S Rank- State Rank
BMPs- Best Management Practices	SWAP- State Wildlife Action Plan
B-Rank- Biodiversity Rank	TCF- The Conservation Fund
CFA- Conservation Focus Area	TNC- The Nature Conservancy
CCV- Cave Conservancy of the Virginias	TU- Trout Unlimited
CCVI- Climate Change Vulnerability Index	USDA- United States Department of Agriculture
CERW- Cerulean Winged Warbler	USFWS- United States Fish and Wildlife Service
CREP- Conservation Reserve Enhancement Program	WMA- Wildlife Management Area
CRP- Conservation Reserve Program	WVACS- West Virginia Association for Cave Studies
CSP- Conservation Stewardship Program	WVASS- West Virginia Speleological Survey
ESH- Early-Successional Habitat	WVCA- West Virginia Conservation Agency
EQIP- Environmental Quality Improvement Program	WVCC- West Virginia Cave Conservancy
FSA- Farm Service Agency	WVDA- West Virginia Department of Agriculture
FSC- Forest Stewardship Council	WVDHHR- West Virginia Department of Health and Human Resources
G Rank- Global Rank	WVDNR- West Virginia Division of Natural Resources
GWWA- Golden-winged Warbler	WVDEP- West Virginia Department of Environmental Protection
HUC- Hydrologic Unit Code	WVDOLF- West Virginia Division of Forestry
NRCS- Natural Resources Conservation Service	WVDOH- West Virginia Division of Highways
NSS- National Speleological Society	WVLT- West Virginia Last Trust
NWTF- National Wild Turkey Foundation	WVU- West Virginia University
OHCF- Outdoor Heritage Conservation Fund	

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the first revision to 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 the Action Plan for the Bluestone River/Peters Mountain CFA. The 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, karst and cave habitats, and developed and agricultural habitats. It also identifies 341 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 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. An implementation plan for each major habitat type lists partners and programs available to assist with each of the actions as well as 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 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 the CFA.

Conserving wildlife species and their habitat within the 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; implement and monitor conservation actions; facilitate stakeholder collaboration; and update the 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 priority species 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.

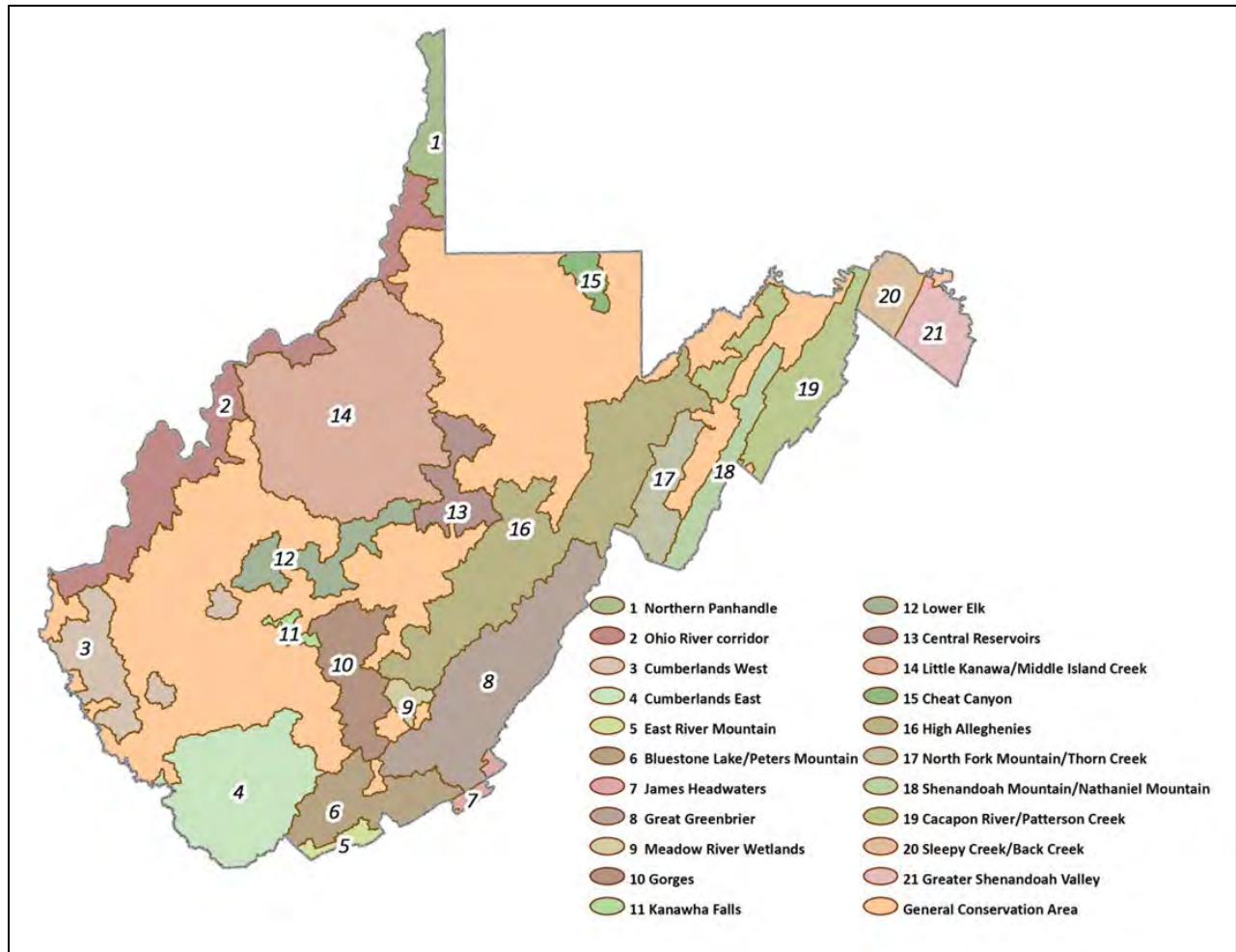
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve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

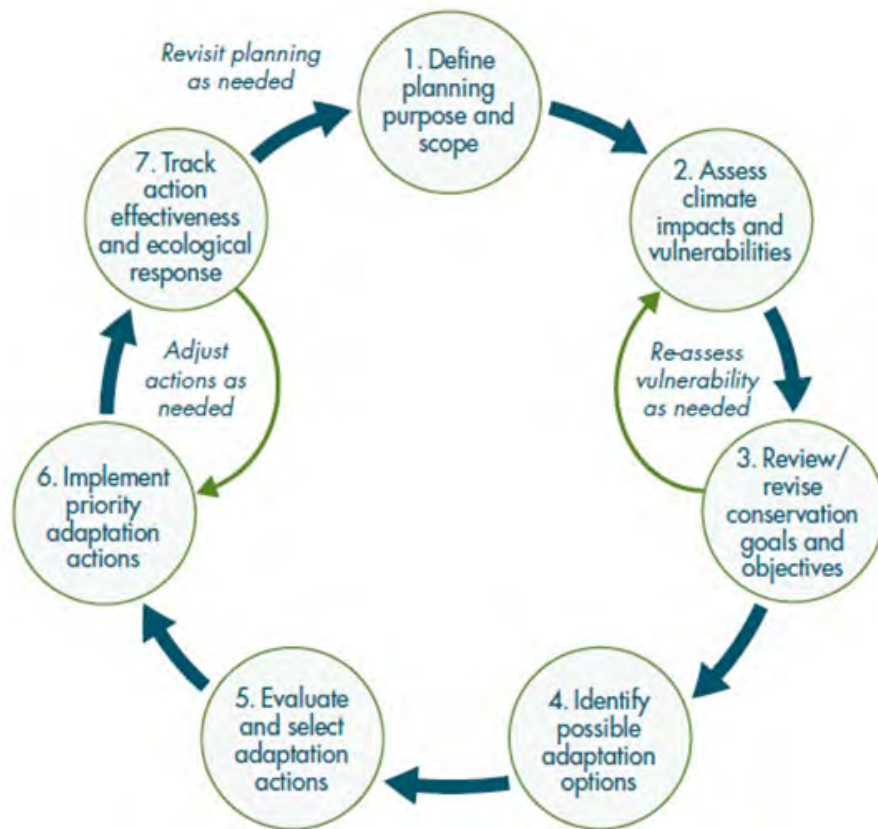
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, 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 vulnerable 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

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:

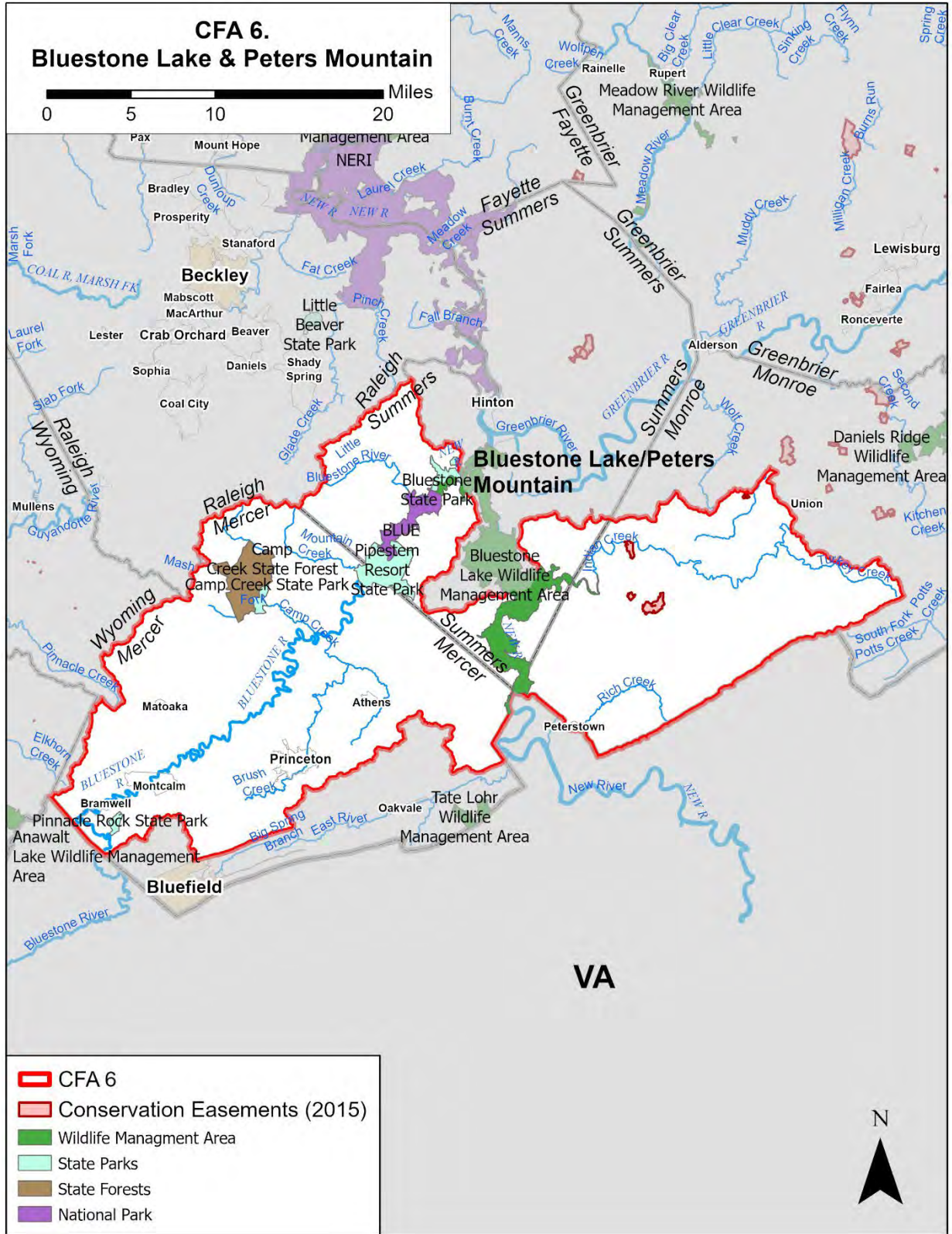
- Confirm whether specific priority wildlife species and habitats are present at specific sites
- Understand species and habitat vulnerability to climate change
- Further define or confirm stresses on wildlife species and habitats
- Tailor proposed wildlife conservation actions to alleviate stresses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

Bluestone Lake and Peters Mountain Conservation Focus Area

Overview

This diverse landscape, spanning across parts of the Allegheny Mountains and Ridge and Valley ecoregions, has a wide variety of landforms including karst topography, big rivers, deep river gorges, and high mountain ridges. The Bluestone Dam forms the 2,040-acre Bluestone Reservoir on the New River. Upstream from Bluestone Reservoir, the New River flows freely for 13 miles upon entering West Virginia from Virginia. The Bluestone River flows out of Virginia, eventually enters the Bluestone Gorge and finally empties into the reservoir from the south. Indian Creek drains much of Monroe County and then flows into the reservoir from the north. A large portion of this Conservation Focus Area (CFA) is a karst area that is a southward extension of the Greenbrier Valley karst. East of this karst area is the high ridge of Peters Mountain, the beginning of the Ridge and Valley Ecoregion. Elevations are generally moderate (2,000 – 2,500 feet) but rise over 4,000 feet on Peters Mountain. Land use changes substantially across the landscape due to the broad variety of habitats and landforms. Forested areas characterize the Bluestone Gorge and Peters Mountain. Elsewhere in the CFA the forests have been fragmented by farming and small communities.

Map 2. Overview



Habitats

Bluestone Lake and Peters Mountain CFA includes a variety of terrestrial, aquatic and subterranean habitat types.

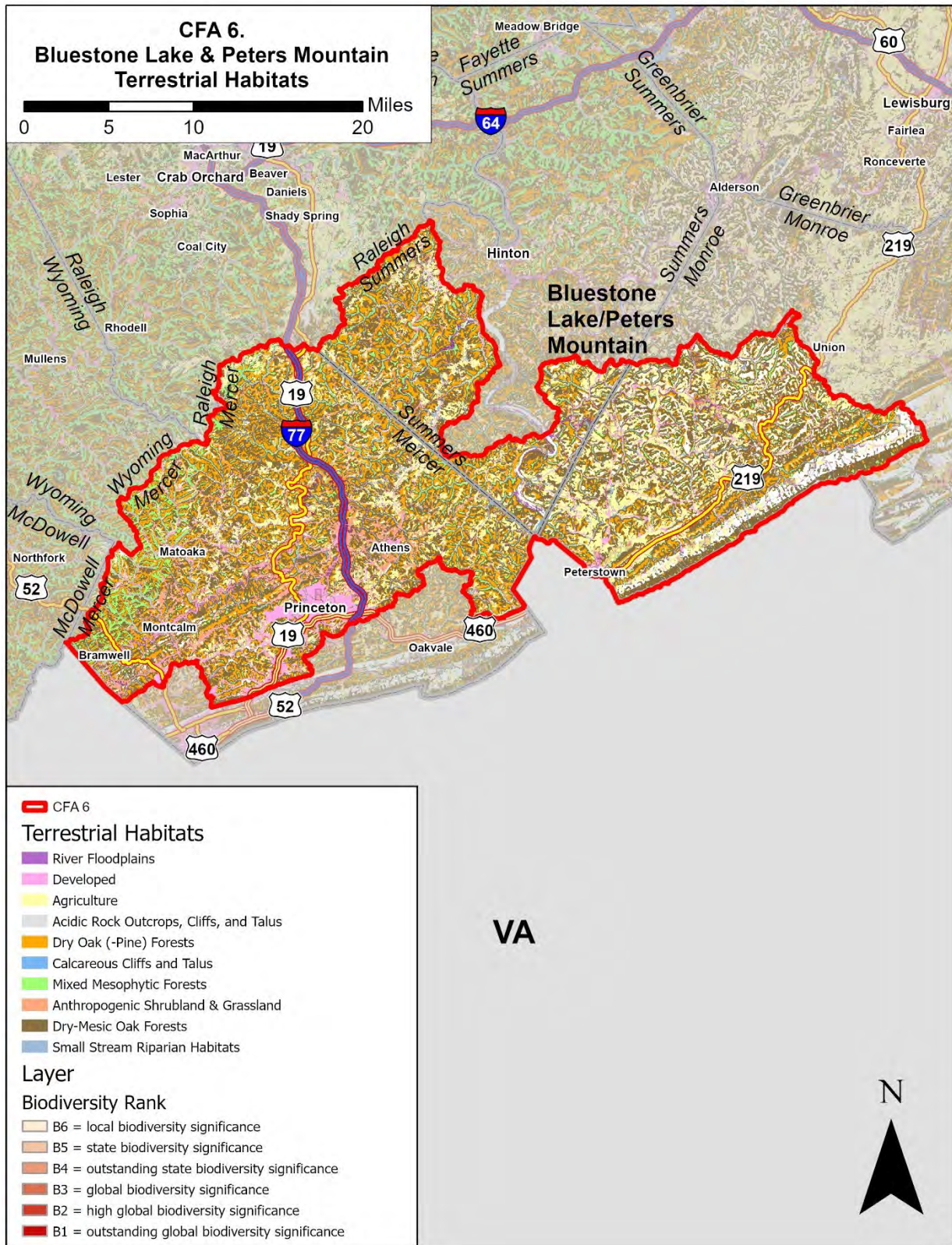
Terrestrial Habitats

Fourteen of the habitat types described in the SWAP are present in this CFA. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP. Developed areas are concentrated around Princeton, and Dry Calcareous Forests, Woodlands and Glades are found along Peters Mountain. Forest and agricultural habitats are interspersed throughout the CFA.

Table 1. Terrestrial Habitat Summary

Habitat Type	Acres in CFA	% of CFA Area	% of WV Total for Habitat Type
Acidic Rock Outcrops, Cliffs, and Talus	165	0.27%	0.18%
Agriculture	5,419	8.99%	0.38%
Anthropogenic <u>Shrubland & Grassland</u>	1,110	1.84%	0.70%
Calcareous Cliffs and Talus	89	0.15%	0.96%
Developed	8,656	14.36%	0.76%
Dry Calcareous Forests, Woodlands, and Glades	5,559	9.22%	7.77%
Dry Oak (-Pine) Forests	10,659	17.68%	0.43%
Dry- <u>Mesic</u> Oak Forests	19,943	33.08%	0.40%
Heath-Grass Barrens	0	0.00%	0.00%
High Allegheny Wetlands	0	0.00%	0.00%
Mixed <u>Mesophytic</u> Forests	2,654	4.40%	0.09%
<u>Montane</u> Red Oak Forests	148	0.24%	0.70%
Northern Hardwood Forests	164	0.27%	0.02%
Pine-Oak Rocky Woodlands	592	0.98%	0.78%
Red Spruce Forests	0	0.00%	0.00%
River Floodplains	140	0.23%	0.12%
Shale Barrens	0	0.00%	0.00%
Sinkhole and Depression Ponds	0	0.00%	0.00%
Small Stream Riparian Habitats	1,397	2.32%	0.28%
Unresolved	3,586	5.95%	3.07%
Totals	60,280	100.00%	

Map 3. Terrestrial Habitats



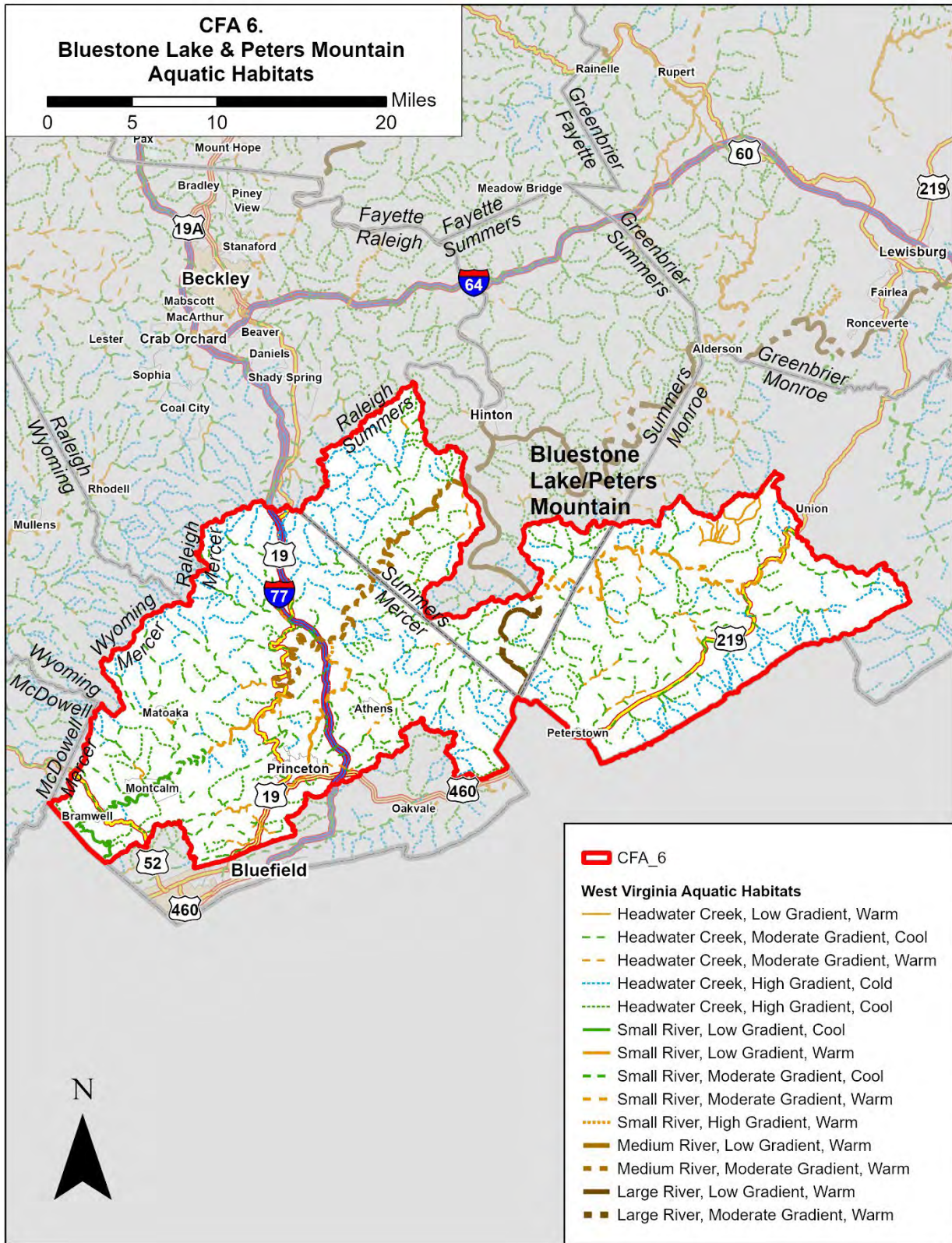
Aquatic Habitats

All fourteen of the aquatic habitat types described in the SWAP are present within the Bluestone Lake and Peters Mountain CFA. Over 85% of the streams in the CFA are headwaters creeks. The upper Bluestone River represents over 20% of the state's cool, low gradient, small rivers, and transitions to a warm, moderate gradient, small river and then a warm, moderate gradient, medium river. Indian Creek is a warm, moderate gradient, small river. The New River is a warm, low gradient, large river.

Table 2. Aquatic Habitat Summary

Habitat Type	Acres in CFA	% of CFA Area	% of WV Total for Habitat Type
Headwater <u>Creek, Low Gradient, Warm</u>	34	3.76%	6.11%
Headwater <u>Creek, Moderate Gradient, Cool</u>	205	22.63%	9.33%
Headwater <u>Creek, Moderate Gradient, Warm</u>	38	4.15%	0.96%
Headwater <u>Creek, High Gradient, Cold</u>	270	29.88%	9.22%
Headwater <u>Creek, High Gradient, Cool</u>	237	26.16%	3.78%
Small <u>River, Low Gradient, Cool</u>	8	0.90%	21.47%
Small <u>River, Low Gradient, Warm</u>	15	1.65%	3.25%
Small <u>River, Moderate Gradient, Cool</u>	15	1.60%	3.11%
Small <u>River, Moderate Gradient, Warm</u>	39	4.32%	7.19%
Small <u>River, High Gradient, Warm</u>	2	0.19%	10.57%
Medium <u>River, Low Gradient, Warm</u>	5	0.57%	1.08%
Medium <u>River, Moderate Gradient, Warm</u>	28	3.14%	8.19%
Large <u>River, Low Gradient, Warm</u>	7	0.77%	1.21%
Large <u>River, Moderate Gradient, Warm</u>	2	0.27%	2.23%
Totals	905	100.00%	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa listed in the SWAP for the Bluestone Lake and Peters Mountain CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibians	19
Birds	38
Butterflies and Moths	6
Cave Invertebrates	15
Crayfish	2
Dragonflies and Damselflies	8
Fish	5
Mammals	7
Mussels	13
Plants	57
Reptiles	8
Snails	16
Tiger Beetles	17
Totals	185

Numerous caves in the karst area contain several highly localized, endemic cave invertebrates and Indiana Bats. Two caves contain invertebrate species found only at that site and nowhere else. The New River Basin is home to:

- Ten fish Species of Greatest Conservation Need (SGCN) endemic to WV (of which at least seven have been documented in this CFA).
- Bluestone Sculpin (a fish species endemic to the Bluestone Watershed).
- Thirteen mussel SGCN.

Extensive farmland (contiguous with the Greenbrier River CFA) supports Anthropogenic Shrub land and Grassland habitats important for several bird species of concern including:

- Barn Owl
- Golden-winged Warbler
- Grasshopper Sparrow
- Eastern Meadowlark

Forested areas are important for forest interior breeding birds such as:

- Worm-eating Warbler
- Wood thrush

And rare plants such as:

- Carolina lily – The only known population in West Virginia.
- Virginia Spiraea (listed as *threatened* under the federal Endangered Species Act).
- American barberry

This CFA has a significant amount of Dry Calcareous Forest, Woodlands, and Glades habitat, which supports a rich diversity of snails (16 SGCN), including the recently described *Triodopsis juxtidentis robiniae* and a newly discovered and still undescribed *Triodopsis*, both of which may possibly be endemic to the Bluestone River Gorge. These calcareous habitats also support a number of rare plants, such as the globally rare Canby's Mountain-lover. Peters Mountain is an important bird migration corridor.

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

Distinctive Stresses

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

- Cave and karst habitats are particularly threatened by
 - Sinkhole dumping
 - Run-off from development and agriculture
 - Quarry operations
- Upland and ridgetop habitats, and particularly Peters Mountain, are potentially threatened by
 - Wind energy which could impact migrating bats and birds
 - Forest fragmentation
- Aquatic habitats are vulnerable to
 - Run-off (sediment, nutrients, other pollution) from development and agriculture

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 actions in the CFA, listed below.

- Terrestrial and Karst Restoration- Engage and work with landowners, the caving community, and environmental agencies to clean up sinkholes, install fencing around sinkholes and sinking streams, and to reduce other impacts to cave and karst systems.
- Habitat Protection - Seek conservation opportunities and secure conservation lands, through ownership or conservation easements, to protect significant terrestrial, subterranean, and aquatic habitats.
- Terrestrial Habitat Conservation –Engage and work conservation agencies to provide assistance and incentives to landowners to maintain grassland and shrub land habitats for birds.
- Aquatic Habitat Restoration – Engage and work with landowners, conservation agencies, and even the Division of Highways to reduce runoff from development and agriculture through road design and implementing best management practices.

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

Potential Partners

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

- WV Department of Environmental Protection
- West Virginia Cave Conservancy
- West Virginia Division of Highways
- Institute for Earth Education
- National Park Service
- USDA-Natural Resources Conservation Service
- county farmland protection programs
- land trusts

With an established “constituency”, 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 4 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

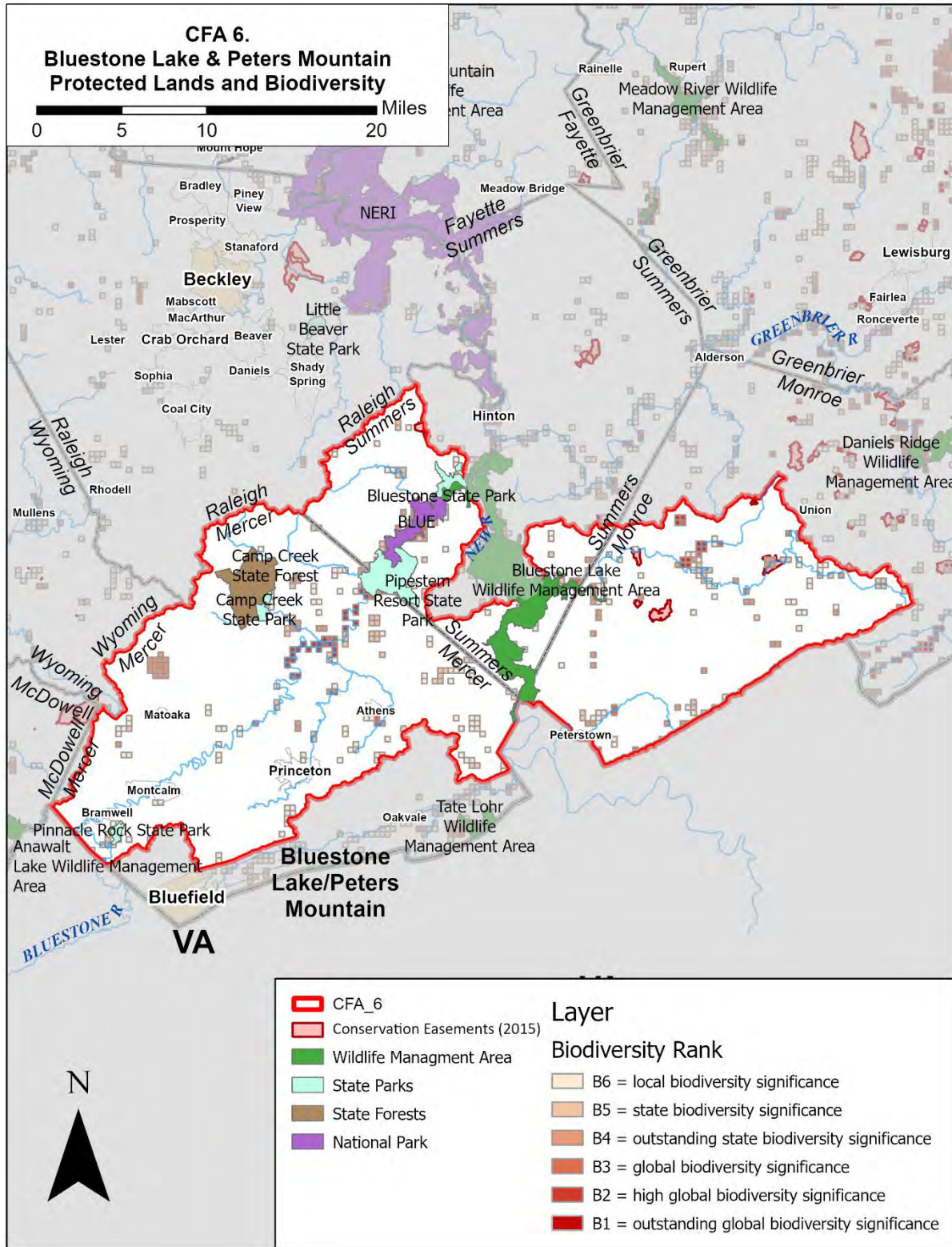
Public lands that may provide significant opportunities for wildlife conservation include:

- Pipestem State Park
- Bluestone Lake State Park and Bluestone Wildlife Management Area
- Bluestone National Scenic River
- Camp Creek State Forest and 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.

Map 5 shows the location of the protected lands in the CFA, based on data provided in 2015 by The Conservation Fund (TCF), USGS Gap Analysis Program (GAP), The Nature Conservancy (TNC) and the National Conservation Easement Database (NCED). This includes the public lands listed above, plus several conservation easements in Monroe County. It also shows known occurrences of SGCNs and rare plant communities over a 1-kilometer grid and the biodiversity rank (including global, state, or local significance) of those occurrences, as generated by WVDNR in 2017. This map illustrates that many SGCN and rare plant communities occur on protected lands and there may be opportunities for WVDNR to protect them there. Many SGCN and rare plant communities also occur on private land outside of protected lands. This indicates how important it is for WVDNR and other partners to work with landowners to restore and protect biodiversity on private lands. Appendix 4 lists partners and programs that provide assistance to private landowners in wildlife conservation.

Map 5. Protected Lands and Biodiversity



Action Plan for the Conservation Focus Area

Conservation Goals

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

1. Halt the decline of at-risk species and thus avoid the need for federal listing as threatened or endangered
2. Assist with the recovery of federally listed species
3. Keep the 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

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	<i>Ambystoma jeffersonianum</i>	Jefferson Salamander	S2	G4
Amphibians	<i>Aneides aeneus</i>	Green Salamander	S3	G3G4
Amphibians	<i>Desmognathus kanawha</i>	Black-bellied Salamander	S3	G5
Amphibians	<i>Desmognathus welteri</i>	Black Mountain Salamander	S2	G4
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander	S3	G5
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander	S3	G4
Amphibians	<i>Plethodon pauleyi</i>	Yellow-spotted Woodland Salamander	S4	G4
Amphibians	<i>Pseudotriton montanus diastictus</i>	Midland Mud Salamander	S1	G5T5
Butterflies and Moths	<i>Calephelis borealis</i>	Northern Metalmark	S1	G3G4
Butterflies and Moths	<i>Erora laeta</i>	Early Hairstreak	S2	GU
Butterflies and Moths	<i>Erynnis martialis</i>	Mottled Duskywing	S3	G3
Butterflies and Moths	<i>Argynnis diana</i>	Diana Fritillary	S2	G3G4
Cave Invertebrates	<i>Batriasymmodes parki</i>	A beetle	SH	GH
Cave Invertebrates	<i>Pseudanophthalmus orthosulcatus</i>	A Cave Beetle	S1	G1
Cave Invertebrates	<i>Pseudosinella testa</i>	Shelled Cave Springtail	S1	G2G3
Dragonflies and Damselflies	<i>Ophiogomphus rupinsulensis</i>	Rusty Snaketail	S2	G5
Dragonflies and Damselflies	<i>Cordulegaster erronea</i>	Tiger Spiketail	S2	G4
Dragonflies and Damselflies	<i>Ophiogomphus incurvatus alleghaniensis</i>	Appalachian Snaketail	SH	G3T2T3
Dragonflies and Damselflies	<i>Ophiogomphus rupinsulensis</i>	Rusty Snaketail	S2	G5
Dragonflies and Damselflies	<i>Somatochlora elongata</i>	Ski-tipped Emerald	S3	G5
Dragonflies and Damselflies	<i>Somatochlora linearis</i>	Mocha Emerald	S3	G5
Dragonflies and Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail	S3	G4

Taxa	Scientific Name	Common Name	S Rank	G Rank
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4
Reptiles	<i>Terrapene carolina carolina</i>	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

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. Dry-Mesic Oak Forests cover over a third of the CFA and represent the largest proportion of forest habitat types, followed by Dry Oak-Pine Forests covering slightly less than 20% of the CFA. There are also corridors of Dry Calcareous Forests, Woodlands and Glades along Peters Mountain in the southeast, and Mesophytic Forests clustered along the Mercer County line in the western side of the CFA. The diversity of forest types across elevational gradients provides great opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches provide core habitat for a significant proportion of SGCN and rare communities, as well as a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change. The largest remaining forest patches are found along the northern end of the Bluestone River and the area around Pipestem State Park, and spanning the Virginia border along Peters Mountain in the southeast part of the CFA. The remainder of the CFA is covered by smaller, more fractured forest patches. A significant portion of the biodiversity occurrences appear concentrated within the larger forest patches, but many also occur in more fragmented forests.

Map 7 also displays rock outcrop, cliff and talus habitats. Acidic rock outcrops, cliffs and talus are concentrated along the Bluestone River and dispersed throughout the western portion of the CFA. Calcareous cliffs and talus are concentrated along the New River, and dispersed in the eastern portion of the CFA. These habitats are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Those outside of larger forest blocks may be stressed by habitat disturbance and degradation. There are numerous occurrences of rare species in these habitats.

Priority Species

The table below lists 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	<i>Aneides aeneus</i>	Green Salamander
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander
Amphibians	<i>Plethodon pauleyi</i>	Yellow-spotted Woodland Salamander
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler
Birds	<i>Hylocichla mustelina</i>	Wood Thrush

Taxa	Scientific Name	Common Name
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler
Birds	<i>Setophaga discolor</i>	Prairie Warbler
Birds	<i>Vermivora chrysoptera</i>	Golden-winged Warbler
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler
Butterflies and Moths	<i>Argynnis diana</i>	Diana Fritillary
Butterflies and Moths	<i>Calephelis borealis</i>	Northern Metalmark
Butterflies and Moths	<i>Erora laeta</i>	Early Hairstreak
Butterflies and Moths	<i>Erynnis martialis</i>	Mottled Duskywing
Dragonflies and Damselflies	<i>Cordulegaster erronea</i>	Tiger Spiketail
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle

Large, intact forest blocks support many forest interior breeding birds, including Cerulean Warbler, Wood Thrush and Worm-eating Warbler. Early-successional forest habitats support species such as Ruffed Grouse, Golden-winged Warbler, Blue-winged Warbler and Prairie Warbler. Eastern Whip-poor-will can be found in forests with open understories or around agricultural areas. Eastern Box Turtle can be found in moist, bottomland forests and grasslands.

Rare Plant Communities

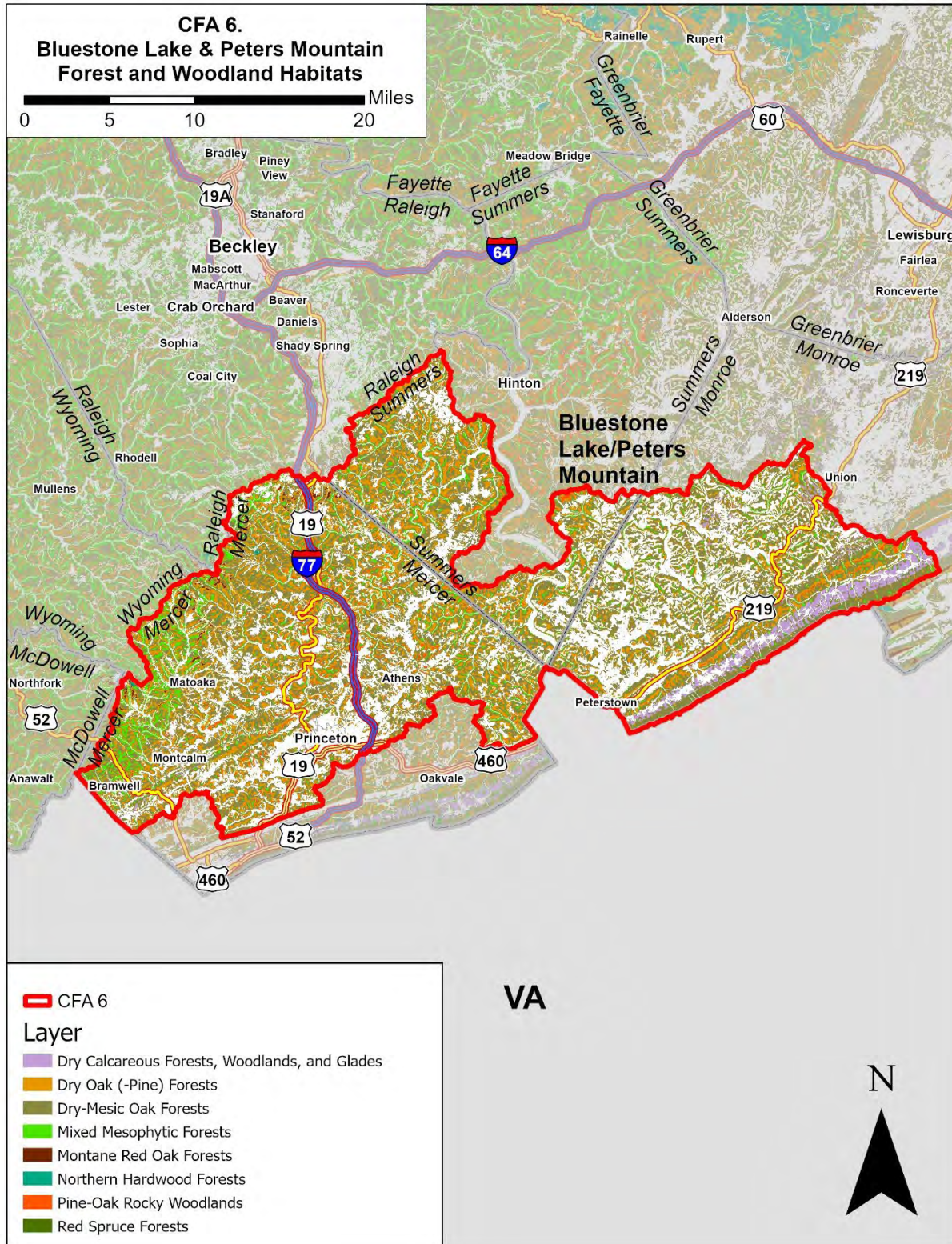
The following rare plant communities are found in Forest and Woodland habitats in this CFA. All of the state's Chestnut Oak-Virginia Pine-Post Oak Woodland are found within this CFA, along with half of its Southern Appalachian High Elevation Red Oak/Heath Forest and a third of its Chinquapin Oak-Bitternut Hickory Limestone Forest.

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

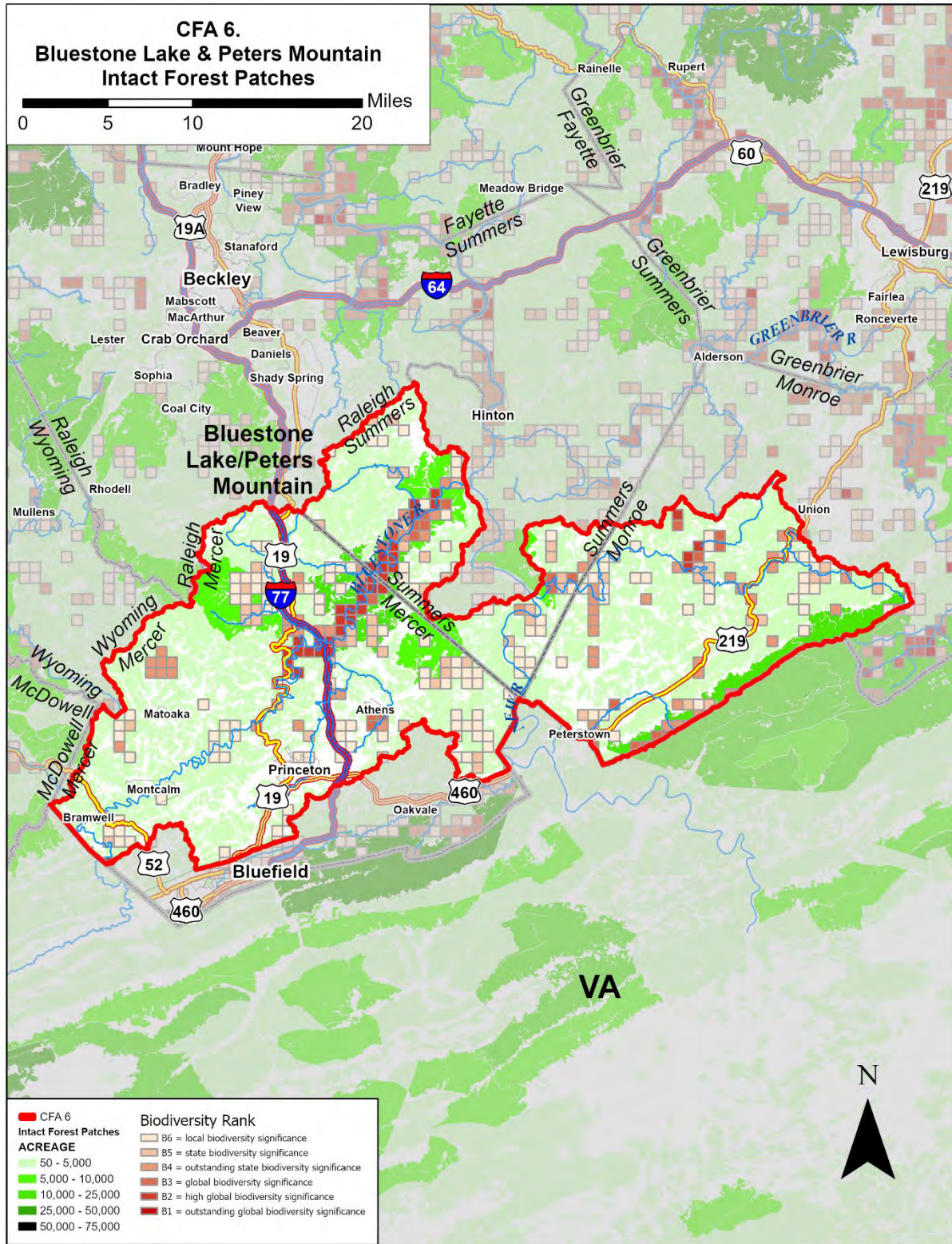
Common Name	Relative Abundance	G Rank	S Rank
Chestnut Oak - Virginia Pine - Post Oak Woodland	1	G3?	S2
Southern Appalachian High Elevation Red Oak / Heath Forest	0.5	G4	S1
Chinquapin Oak - Bitternut Hickory Limestone Forest	0.3	G3G4	S3

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## or G## indicates range of uncertainty of conservation status.

Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



Habitat Stresses and Conservation Actions

Table 7 lists stresses impacting species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses. Maintaining a diverse population of forest birds requires dynamic forest landscapes with mosaics of age classes, structural and spatial complexity. Efforts to manage and restore both early-successional and late-successional, interior forest habitats are needed for many SGCN. Several priority salamander species depend on rare rock and cave habitats within forested landscapes and are sensitive to forest fragmentation and disturbance. Interior forest birds are threatened where there is an overabundance of deer browsing in the understory, forest fragmentation and related brood parasitism and nest predation. Other bird species are stressed by forest maturation and the loss of early-successional habitat. In addition to habitat impacts, Eastern Whip-poor-will are stressed by road collision mortality, and American Woodcock populations are impacted by hunting, particularly if the decline in migrants increases hunting pressure on the breeding population. Ruffed Grouse suffer from the impacts of West Nile Virus. Eastern Box Turtle are threatened by road collisions, disease, and illegal collection. Timber Rattlesnakes suffer from illegal collection and persecution. Outside of West Virginia, species including Golden-winged Warbler and Blue-winged Warbler are stressed by habitat loss in their wintering grounds.

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

Habitat Stress	Conservation Action
Forest fragmentation, poor water quality, climate change and disturbance of rock outcrops, caves, springs, seeps, streams, and ponds	Maintain and protect forest cover and hydrology, especially around caves, springs, calcareous rock and other rare habitat features
Wind energy development- potential impact on migrating bats and birds	Avoid wind energy development in crucial migratory corridors
Early-successional habitat: poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early-successional habitat across 15-20% of forested landscapes and structural complexity, including gaps with healthy native grasses, forbs, vegetative cover and snags
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity: old growth, small openings with well-developed understories, snags and decaying logs
Invasive plants related to forest fragmentation, climate change	Maintain forest cover and control invasive plants, especially around larval host and nectar plants for priority butterfly and moth species and rare plant communities

Habitat Stress	Conservation Action
Poor forest structure- lack of open understory	Use forest management and prescribed fire to promote open understories for Whip-poor-wills
Deer browse impacting forest structure, as well as reducing larval host and nectar plants for butterflies and moths	Manage local deer populations where abundant
Decline of healthy abundant, fruiting stands of American beech due to beech canker fungus	Avoid disturbance of mature beech stands Outreach to landowners about new protocols to improve the health of impacted or vulnerable beech stands
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

Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et al., 2015) describes 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. 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 more susceptible to 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. 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 a 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.

Dry Calcareous Forests, Woodlands and Glades are adapted to heat, drought and wildfire, but may be impacted by increased fire intensity, correlated with increases in invasive plant species. Management of invasive plants will be critical for the long-term resilience of the ecosystem. Dependence on unique soils may impede the ecosystem's ability to shift across the landscape.

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

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

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

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

Climate Stresses	Habitat Resilience Actions
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Restore or maintain fire in fire-adapted ecosystems • Manage deer populations to promote regeneration • Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plants and remove existing invasive plants • 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 or geologic features, such as calcareous forests, woodlands and glades, rock outcrops, cliffs and talus • Protect forest reserves in areas of high biological diversity or priority species • Reduce forest fragmentation • Maintain or restore large patches and corridors of forest habitat • Restore native forest vegetation on deforested lands within and adjacent to forested areas

Implementation Plan

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

Table 9. Implementation Plan for Forest and Woodland Habitats

Action	Partners	Effectiveness Measures
<p>Develop and Implement Plans to Manage Forest Habitats</p> <ul style="list-style-type: none"> • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs • USDA NRCS Climate Smart Forestry Activities 	<ul style="list-style-type: none"> • AFF • AFTS, FSC, SFI • AMJV • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WVDOF 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Forest Habitat, Reserve and Corridor Protection (and migratory corridors):</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition • Natural Area designation 	<ul style="list-style-type: none"> • County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • WVDNR • WVDOF Forest Legacy 	<ul style="list-style-type: none"> • Acres of habitat protected • Abundance and diversity of priority species and habitats
<p>Manage forests at landscape scale for diversity of native species and age classes, structural and spatial complexity appropriate for the forest type</p>	<ul style="list-style-type: none"> • AMJV • Consulting Foresters • Forest Certification Programs: AFTS, FSC, SFI • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
<p>Restore native forest vegetation on adjacent deforested lands</p>	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species

Action	Partners	Effectiveness Measures
<p>Create or maintain early-successional habitat (ESH) to benefit wildlife species through forest management on appropriate sites.</p> <p>GWWA guidelines for large forest patches with > 70% forest cover:</p> <ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • Consulting Foresters • NWTf and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
<p>Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites</p> <p>CERW guidelines for large forest patches with > 70% forest cover:</p> <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance and diversity of priority species
<p>Forest management to promote open forest understories or canopy gaps</p>	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers USDA NRCS • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species
<p>Monitor and control invasive plants, promptly revegetate disturbed sites</p> <p>Develop NNIS BMPs for timber harvest practices</p>	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS • WVCA and ECD • WVDOF 	<ul style="list-style-type: none"> • Acres of habitat protected or restored • Before and after comparison: abundance and diversity of priority species
<p>Manage deer population where abundant</p>	<ul style="list-style-type: none"> • Private landowners • Public Land Managers • WVDNR (hunting licenses) 	<ul style="list-style-type: none"> • Change in deer population or forest structure • Acres of habitat restored • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Controlled burning by public agencies in fire adapted ecosystems	<ul style="list-style-type: none"> • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species
<p>Avoid disturbance of mature beech stands</p> <p>Outreach to landowners about new protocols to improve the health of impacted or vulnerable American beech stands</p>	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • WVDNR • WVDOF • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat avoided • # landowners reached • Acres of habitat managed to improve the health of beech tree stands
Outreach to landowners to prevent illegal collection of Eastern Box Turtles and collection and persecution of Timber Rattlesnake	<ul style="list-style-type: none"> • USFWS • WVDNR • WVU Extension 	<ul style="list-style-type: none"> • # landowners reached • Before and after comparison: abundance and distribution of priority species
Provide guidance on timber rattlesnake den avoidance	<ul style="list-style-type: none"> • Public land managers • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat restored • Before and after comparison: abundance, diversity and distribution of priority species
Install signage to prevent vehicle collisions with Eastern Whip-poor-will and Eastern Box Turtles at priority road crossings	<ul style="list-style-type: none"> • WVDNR • WVDOH 	<ul style="list-style-type: none"> • # signs installed • Before and after comparison: abundance and distribution of priority species
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> • Mountain RC &D • Public Land Managers • USDA NRCS • WVDEP, WVCA and Conservation Districts • WVDNR • WVDNR, WVDOF • WVU Extension 	<ul style="list-style-type: none"> • # Landowners engaged • # Landowners implementing actions

Human Benefits

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

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from high-gradient, cold headwater creeks to the New River, which is warm, low-gradient, large river. The Bluestone River transitions from a cool, low-gradient, small river to a warm, low gradient, medium river as it flows north. Indian Creek is a warm, low gradient, small river. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are tightly connected with their adjacent floodplains, wetlands and riparian habitats. Many plant and animal species rely on aquatic habitats such as streams, rivers and wetlands, as well as their adjacent terrestrial habitats, especially riparian areas and forests. The loss of natural floodplain habitats and riparian corridors often impacts water quality and adjacent aquatic habitat. Improving wildlife habitat in streams and rivers often requires conservation actions to improve adjacent floodplain and riparian habitats. Therefore aquatic, floodplain, wetland and riparian habitats will be addressed together.

Priority Species

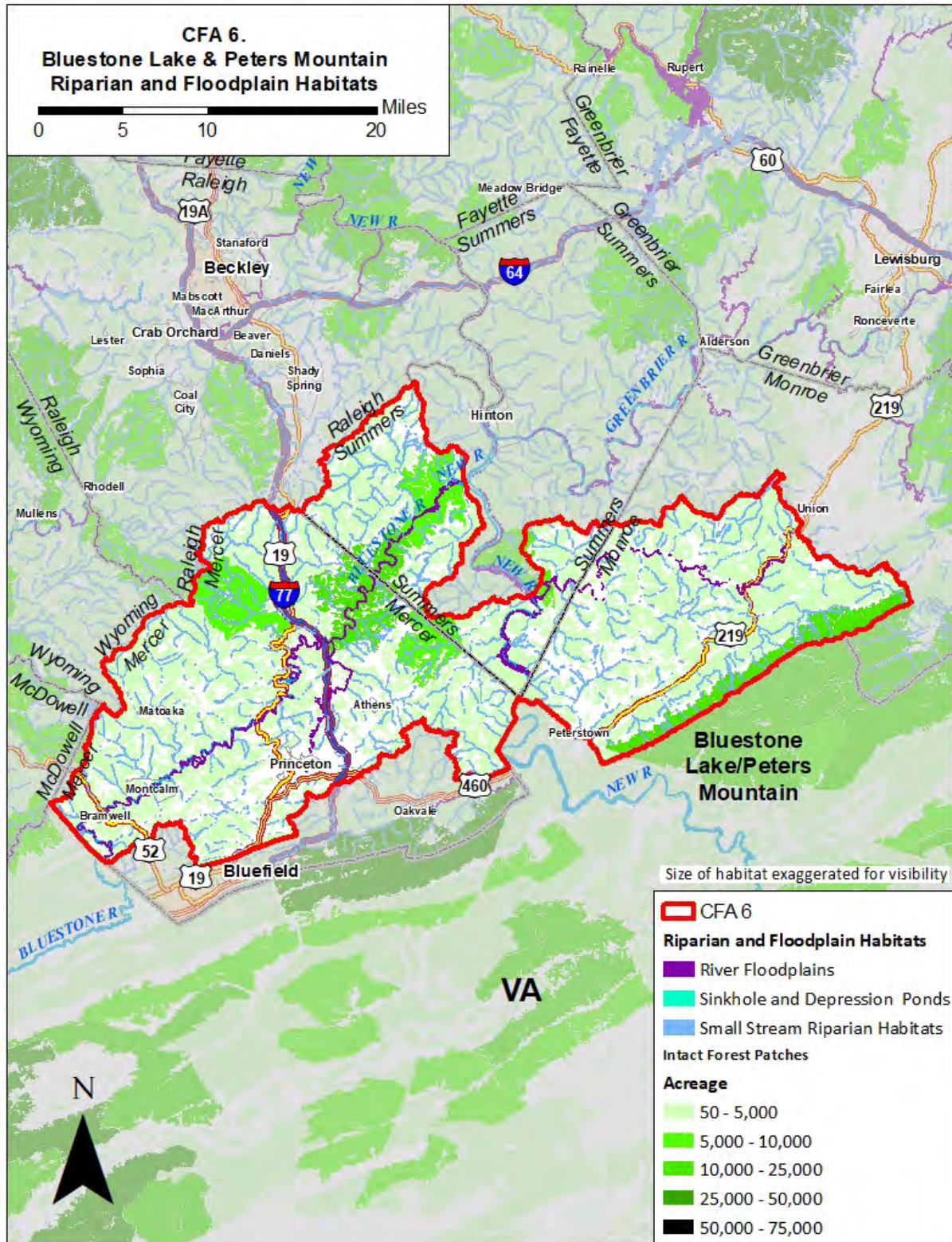
Table 10 lists priority species in the CFA that occur aquatic, riparian and floodplain and wetland habitats.

Table 10. Priority Aquatic, Riparian and Floodplain Species

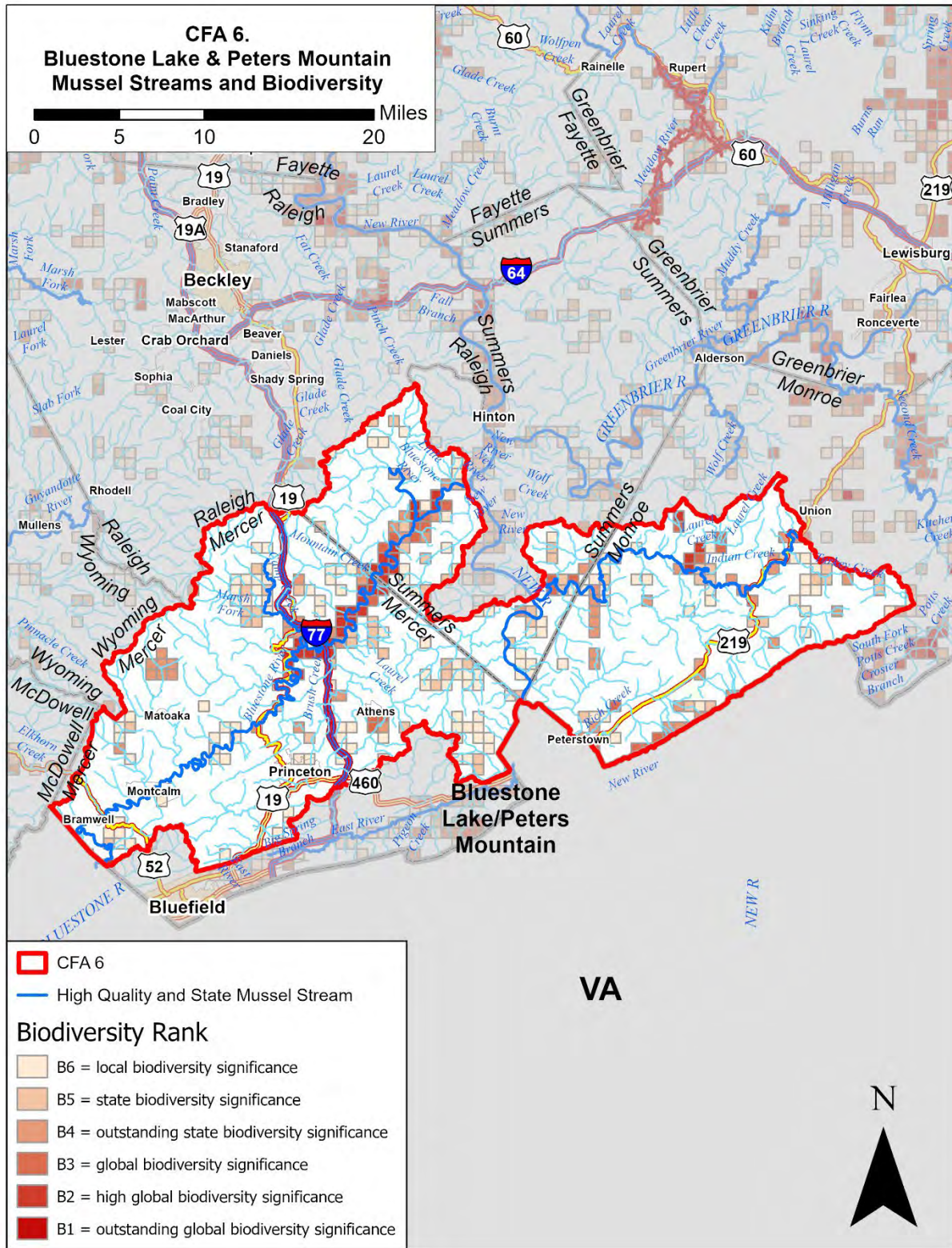
Taxa	Scientific Name	Common Name
Amphibians	<i>Desmognathus kanawha</i>	Black-bellied Salamander
Amphibians	<i>Desmognathus welteri</i>	Black Mountain Salamander
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush
Butterflies and Moths	<i>Argynnis diana</i>	Diana Fritillary
Butterflies and Moths	<i>Calephelis borealis</i>	Northern Metalmark
Dragonflies and Damselflies	<i>Cordulegaster erronea</i>	Tiger Spiketail
Dragonflies and Damselflies	<i>Ophiogomphus incurvatus alleghaniensis</i>	Appalachian Snaketail
Dragonflies and Damselflies	<i>Ophiogomphus rupinsulensis</i>	Rusty Snaketail
Dragonflies and Damselflies	<i>Somatochlora elongata</i>	Ski-tipped Emerald
Dragonflies and Damselflies	<i>Somatochlora linearis</i>	Mocha Emerald
Dragonflies and Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle

Map 9 illustrates riparian and floodplain habitats along with biodiversity, and Map 10 illustrates mussel streams (mapped by WVDNR in 2018), exemplary wetlands (as assembled by WVDNR in 2015) and biodiversity. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. The Biodiversity Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats, especially along the East River and its main tributaries. Most of the river floodplain habitats in the CFA occur along the New River, Bluestone River, and Indian Creek. Those rivers and Camp Creek are also listed as High Quality and State Mussel Streams due to the important, high-quality habitat they provide. Several dragonfly species require additional surveying to determine their distribution and abundance.

Map 9. Riparian and Floodplain Habitats, and Biodiversity



Map 10. Mussel Streams, Wetlands and Biodiversity



Habitat Stresses and Conservation Actions

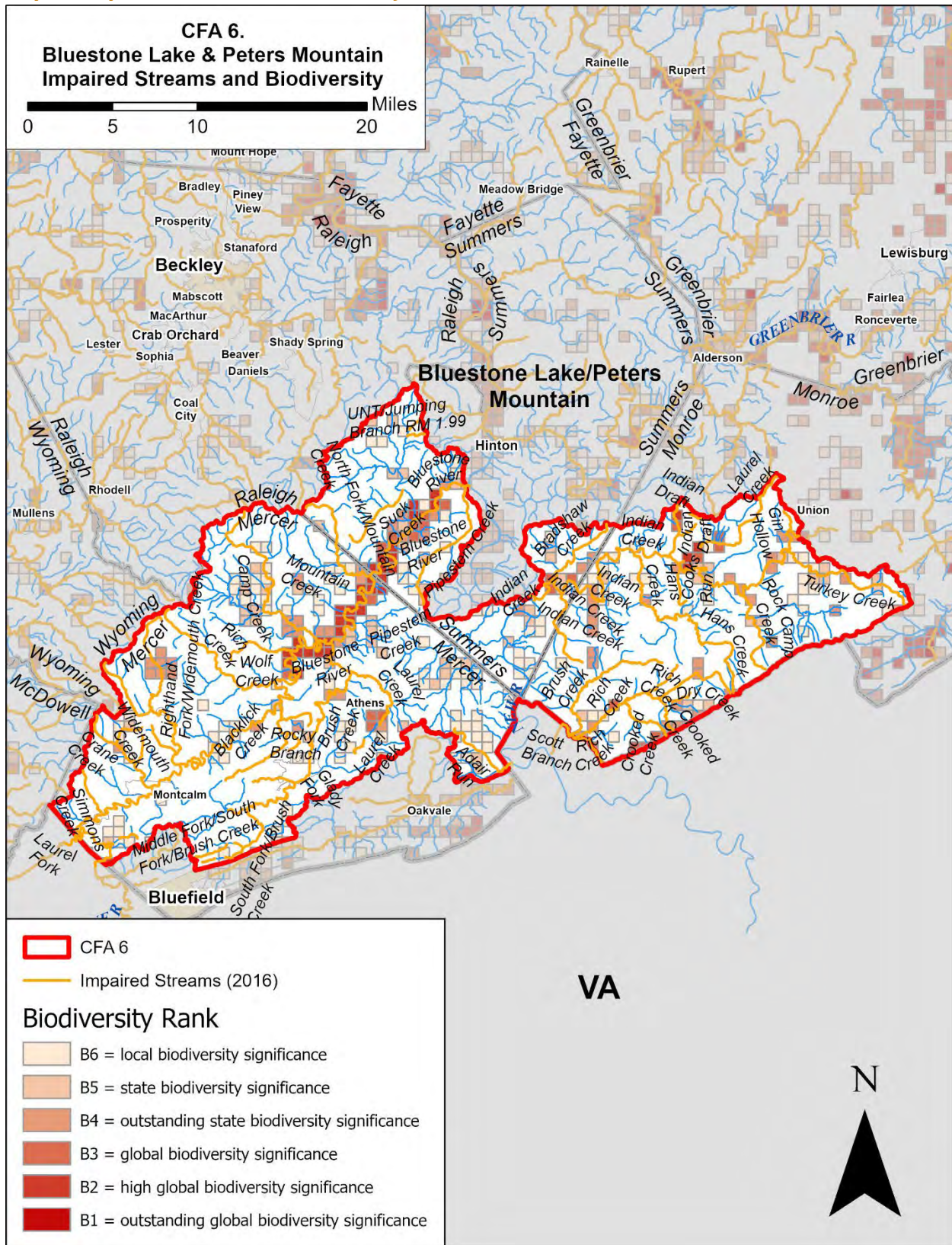
Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for many SGCN including amphibians, birds, fish, mussels, dragonflies and damselflies and plant species. Direct stresses to priority species include illegal collection, road mortality and disease among Eastern Box Turtles, and disease along with collection for fishing bait for priority salamander species.

Map 11 shows stream impairments, along with biodiversity. The Bluestone River is impaired by fecal bacteria, iron, selenium, PCBs and biological impairments. Indian Creek and several of its tributaries suffer from fecal/bacteria, biological and iron impairments (WVDEP, 2016). Many of these impaired streams nonetheless support high biodiversity and provide habitat for priority species. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present. A listing of impaired streams in this CFA is included in Appendix 5.

Table 11. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat

Habitat Stress	Conservation Action
Lack of protected stream, seep, spring, floodplain, wetland, pond and riparian habitat	Habitat protection through land use planning, conservation easements and other programs and activities
Water quality degradation (organic and chemical pollutants, sedimentation, run-off, dredging)	Identify and treat sources of pollution: improved sewage treatment, storm water management, agricultural nutrient load reductions, sediment load reductions
Riparian habitat disturbance and deforestation, road crossings, altered hydrology, increased runoff and stream temperatures, climate change	Landowner outreach Plant, fence, maintain forested riparian corridors Minimize disturbance
Invasive plants: riparian forest fragmentation, climate change	Maintain forest cover and control invasive plants, especially around larval host and nectar plants for priority butterfly and moth species and rare plant communities

Map 11. Impaired Streams and Biodiversity



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.

Below is 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 12. Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat

Climate Stresses	Habitat Resilience Actions
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 13. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
<p>Habitat Protection:</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition • Natural Area designation 	<ul style="list-style-type: none"> • County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA Natural Resource Conservation Service ACEP • WVDEP ILF • WVDNR 	<ul style="list-style-type: none"> • Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Habitat Protection</p> <ul style="list-style-type: none"> • Cost-Share Programs 	<ul style="list-style-type: none"> • USDA 	<ul style="list-style-type: none"> • Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <ul style="list-style-type: none"> Land Use Planning 	<ul style="list-style-type: none"> County Planning Commissions 	<ul style="list-style-type: none"> Acres of habitat protected through land use planning, floodplain and stormwater regulations
In-stream and riparian habitat restoration	<ul style="list-style-type: none"> Public Land Managers Trout Unlimited USDA FSA USDA NRCS USFWS Partners for Fish and Wildlife Restoration 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Trout Unlimited USDA FSA USDA NRCS USFWS Partners for Fish and Wildlife WVDEP and WVCA WVDOF 	<ul style="list-style-type: none"> 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
Identify and improve aquatic passage barriers, increase aquatic connectivity	<ul style="list-style-type: none"> Trout Unlimited USFWS Partners for Fish and Wildlife WVDOH 	<ul style="list-style-type: none"> # barriers enlarged or removed # miles stream opened Before and after comparison: abundance and diversity of priority species
Identify and treat sources of water pollution: Improved wastewater and stormwater treatment	<ul style="list-style-type: none"> County governments Municipalities Trout Unlimited WV Rivers Coalition WVDEP WVDHHR 	<ul style="list-style-type: none"> # 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

Action	Partners	Effectiveness Measures
Improve water quality in streams and wetlands	<ul style="list-style-type: none"> • USDA FSA & NRCS • WVDEP and WVCA 	<ul style="list-style-type: none"> • Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Treat invasive plants in riparian and floodplain habitats	<ul style="list-style-type: none"> • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife 	<ul style="list-style-type: none"> • Acres treated • Treatment success rate • Before and after comparison: abundance and diversity of priority species
Outreach to anglers to prevent use of salamanders for bait	<ul style="list-style-type: none"> • WVDNR 	<ul style="list-style-type: none"> • # anglers reached • Before and after comparison: abundance and distribution of priority species
Outreach to landowners to prevent illegal collection of Eastern Box Turtles	<ul style="list-style-type: none"> • USFWS • WVDNR 	<ul style="list-style-type: none"> • # landowners reached • Before and after comparison: abundance and distribution of priority species
Install signage to prevent vehicle collisions with Eastern Box Turtles at priority road crossings	<ul style="list-style-type: none"> • WVDNR • WVDOH 	<ul style="list-style-type: none"> • # signs installed • Before and after comparison: abundance and distribution of priority species
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> • Mountain RCD • Public Land Managers • USDA NRCS • WVDEP, WVCA and Conservation Districts • WVDNR • WVDNR, WVDOF • WVU Extension 	<ul style="list-style-type: none"> • # Landowners engaged • # Landowners implementing actions

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.

Subterranean Habitats

Karst and Cave Habitats

Areas with karst geology and subterranean caves provide unique habitats that may be influenced by human activities, surface land use, and surface and underground hydrology in the surrounding landscape. Caves provide important habitat for bats that move in and out, as well as a diverse group of vertebrate and invertebrate animals that have evolved specialized adaptations to permanent underground living. Common traits exhibited by permanent cave dwellers (troglobites) include blindness (or complete loss of eyes) and reduced pigmentation.

The next map (based on maps from the WV Geologic and Economic Survey in 1998) illustrates bands of karst geology along Peters Mountain and portions of Indian Creek and the Bluestone River. The karst areas overlap numerous occurrences of rare species. Karst areas outside of the larger forest patches may be more vulnerable to disturbance and degradation.

The map on the subsequent page illustrates biologically significant caves that host rare bat or endemic cave species, or exceptional biological diversity, with 3-mile buffers offset randomly. It also illustrates karst features with 3-kilometer random offset buffers, and karst feature density. This data was provided by the West Virginia Speleological Survey, with offset buffers developed by WVDNR. The map indicates that there are buffer areas around biologically significant caves in the northeast corner of the CFA and around the town of Athens. There are karst features in the northeast, southwest, and central portions of the CFA. These karst areas and significant cave buffers require careful management to minimize disturbance on priority species.

Priority Species

Caves in this CFA host numerous bat and cave invertebrate SGCN that depend on cave and karst habitats for their survival. The cave salamander is a priority species that is found in forests around calcareous rock, springs and caves. Several cave invertebrates rely on cave habitats in this CFA. These species are sensitive to habitat disturbance and degradation.

Table 13. Priority Species in Subterranean Habitats

Taxa	Scientific Name	Common Name
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander
Cave Invertebrates	<i>Batriasymmodes parki</i>	A beetle
Cave Invertebrates	<i>Pseudanophthalmus orthosulcatus</i>	A Cave Beetle
Cave Invertebrates	<i>Pseudosinella testa</i>	Shelled Cave Springtail

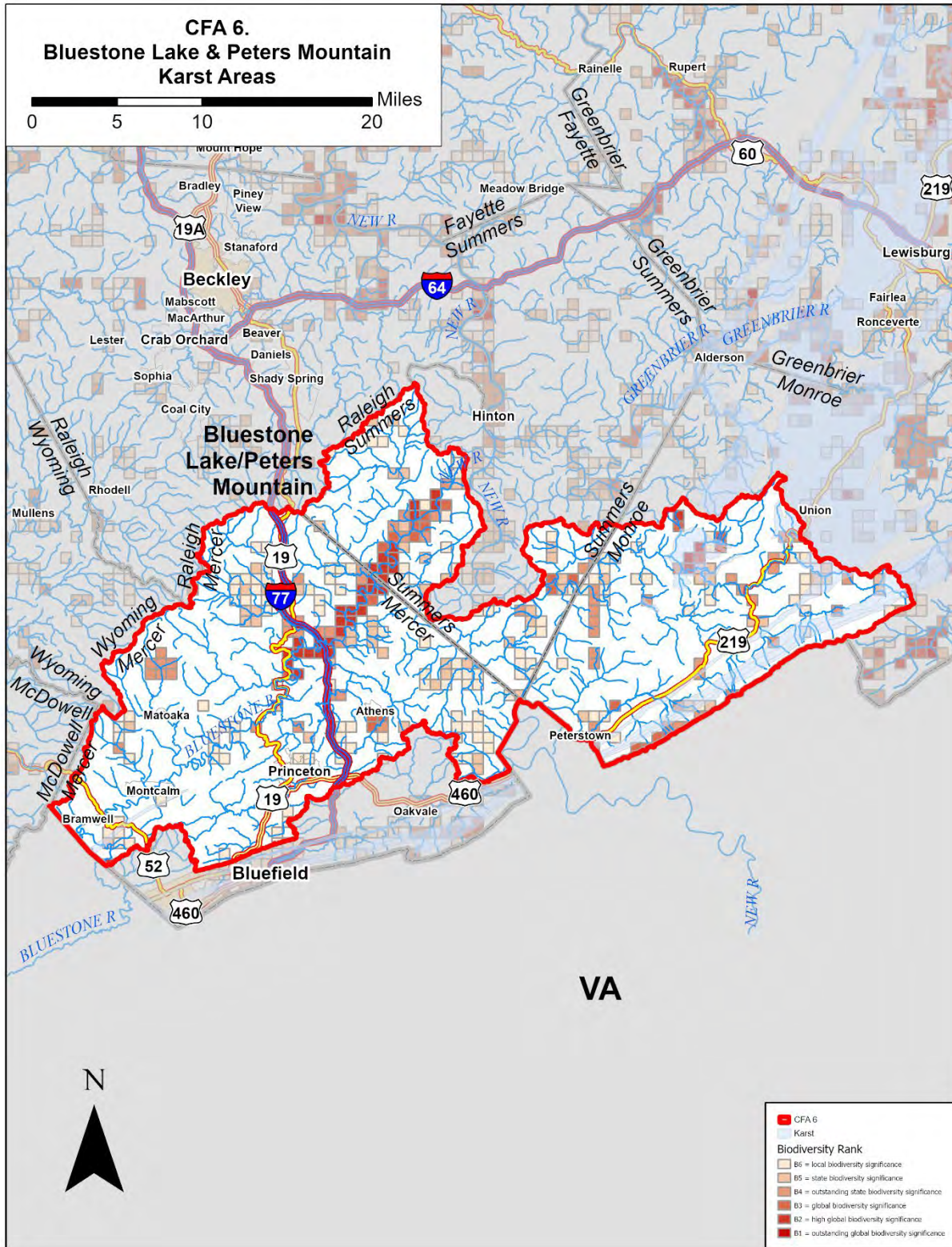
Habitat Stresses and Conservation Actions

Caves and subterranean habitats, particularly in porous karst geology, are impacted by changes to water quality and land use in adjacent areas. The following table lists stresses affecting wildlife in caves and subterranean habitats, and conservation actions landowners and partners can take to address them.

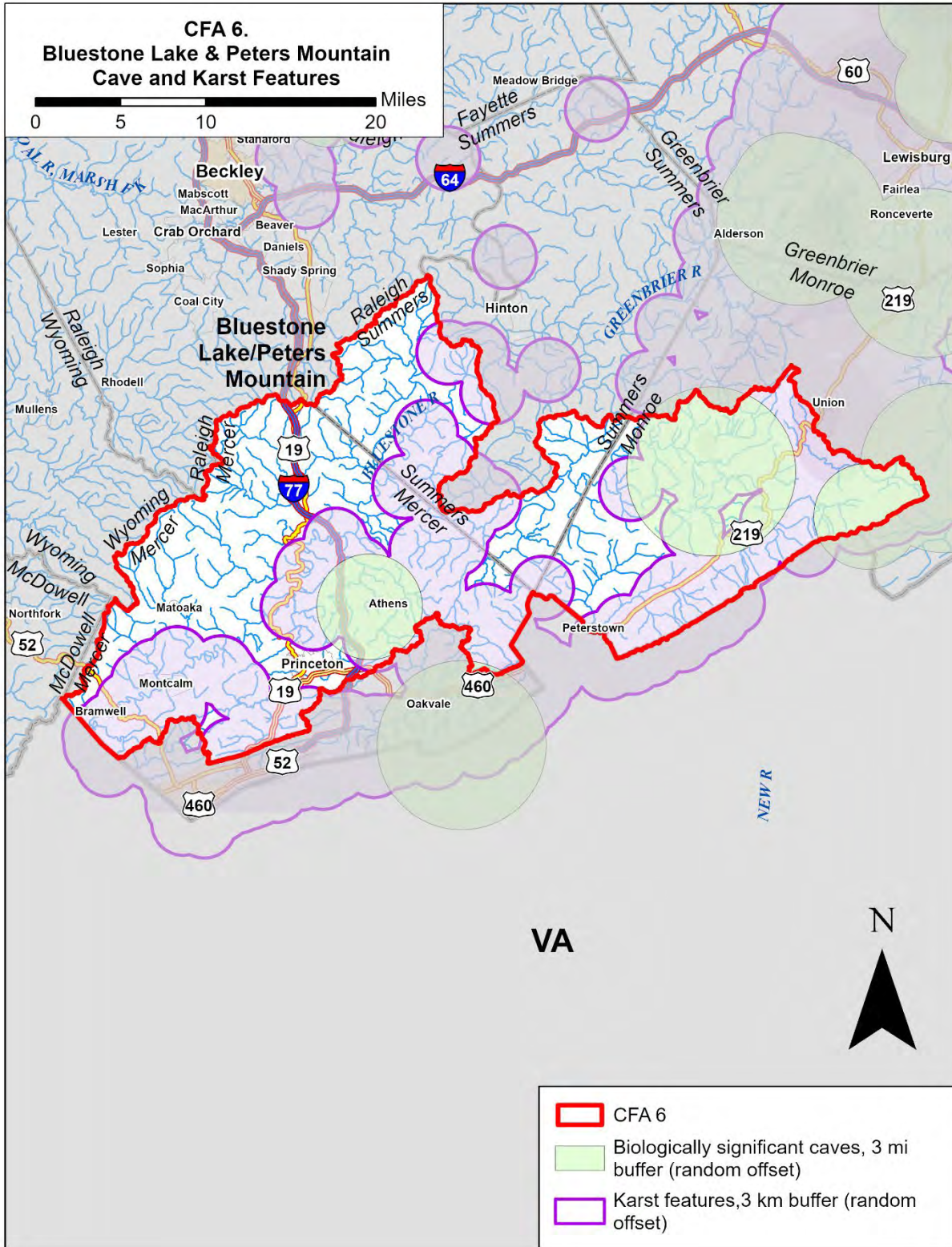
Table 14. Habitat Stresses and Conservation Actions in Subterranean Habitats

Habitat Stress	Conservation Action
Water quality degradation due to development, homebuilding, inadequate wastewater treatment, and agricultural activities resulting in stormwater runoff, sedimentation and nutrient inputs	Identify, clean up and fence sinkholes, sinking streams and other important karst features. Provide outreach and educational materials to landowners, planners, partner agencies. Improve wastewater treatment. Restore and maintain riparian buffers and livestock exclusion fencing.
Habitat disturbance and degradation around caves	Maintain forest cover and hydrology around caves to keep them moist and cool

Map 12. Karst Areas and Biodiversity



Map 13. Karst and Cave Features



Climate Change and Habitat Resilience

The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et al., 2015), noted that ecosystems that are limited by geological or hydrological features, such as cave and karst habitats, may be restricted from shifting across the landscape in response to climate change. However, caves that are connected more closely with groundwater inputs than surface water may be buffered from the impacts of climate change, and caves and karst areas may be buffered from increasing surface temperatures. But caves and karst areas may be vulnerable to groundwater extraction during droughts as well as changes in surface water flow regimes, nutrient inputs and contaminants carried by floods. Restoring and maintaining water quality and natural flow regimes in areas upstream and above caves and karst may boost the resilience of cave ecosystems. Some cave dwelling species also rely on adjacent forest, riparian and aquatic habitats. Maintaining the resilience of adjacent ecosystems could further buffer cave species from the impacts of climate change.

Below is a summary of climate stresses on cave and karst habitats, and actions to boost their resilience. Although climate stresses are listed separately, subterranean habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Some of these actions repeat previously listed conservation actions to reduce stress on priority species and could benefit priority species while also boosting habitat resilience. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Table 15. Climate Stresses and Resilience Actions in Karst and Cave Habitats

Climate Stress:	Habitat Resilience Action:
<ul style="list-style-type: none"> • Increased flood frequency and severity, nutrient inputs and contaminants • Increased surface water temperatures, low-flow events and ground water withdrawals • Increased atmospheric temperatures and loss of adjacent forests and riparian areas 	<ul style="list-style-type: none"> • Restore and protect surface water quality and hydrology • Limit impervious cover • Maintain ground water quality and quantity • Maintain resilient forests, riparian and aquatic habitat around karst and cave ecosystems

Implementation Plan

WVDNR will work with landowners and the following partners and programs to implement and measure the impact of conservation actions around caves and karst habitat.

Table 16. Implementation Plan for Subterranean Habitats

Action	Partners	Effectiveness Measures
<p>Land protection around caves and karst habitat:</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition • Natural Area designation 	<ul style="list-style-type: none"> • County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS ACEP • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected around caves and karst features • Abundance and diversity of priority species and habitats
<p>Land protection around caves and karst habitat</p> <ul style="list-style-type: none"> • Cost-Share Programs 	<ul style="list-style-type: none"> • USDA FSA, NRCS 	<ul style="list-style-type: none"> • Acres of habitat protected • Abundance and diversity of priority species and habitats
<p>Land use planning around caves and karst habitat</p>	<ul style="list-style-type: none"> • County Planning Commissions 	<ul style="list-style-type: none"> • Acres of cave, karst and buffer habitat protected for public health and safety through land use planning ordinances
<p>Stream buffer fencing and riparian plantings around caves and karst</p>	<ul style="list-style-type: none"> • Trout Unlimited • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife Restoration • WVDOF, WVDEP and WVCA 	<ul style="list-style-type: none"> • Acres or linear feet of stream buffer zones planted and fenced • Before and after comparison: abundance and diversity of priority species
<p>Land management around caves and karst</p>	<ul style="list-style-type: none"> • Public Land Managers • Trout Unlimited • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife 	<ul style="list-style-type: none"> • Acres of habitat managed • Before and after comparison: abundance and diversity of priority species
<p>Identification of critical karst features and landowner outreach, cleanups, cave research, mapping, fencing and protection</p>	<ul style="list-style-type: none"> • CCV • NSS and grottos • WVACS • WVASS • WVCC 	<ul style="list-style-type: none"> • # of cave/karst resources protected or restored • # landowners participating in cave/karst protection and restoration activities

Action	Partners	Effectiveness Measures
Improved wastewater treatment around caves and karst habitat	<ul style="list-style-type: none"> • WVDEP • WVDHHR 	<ul style="list-style-type: none"> • # systems installed or improved • Change in fecal and other water quality Before and after comparison: abundance and diversity of priority species

Human Benefits

Actions to restore and protect subterranean habitat may benefit human health and economies in surrounding communities, mainly through the protection of water quality and drinking water sources.

Agricultural and Developed Habitats

Many SGCN rely on agricultural lands, especially pastures and woody vegetation in fallow areas, abandoned fields, field borders, wetlands and riparian corridors. Some species even depend on habitats in residential and urban areas. Map 14 shows the locations of agricultural and developed habitats and highlights biodiversity occurrences in and around these areas. Developed areas are concentrated mainly around Princeton, with small agricultural areas scattered along valley bottoms through the CFA. Grassland birds in particular rely on agricultural areas in this CFA. Some agricultural areas coincide with fertile soils in karst landscapes, where agricultural activities may also impact water quality and subterranean habitats. Maintaining pastures, fallow fields, woody vegetation, wetlands and riparian corridors is a priority for SGCNs in agricultural habitats.

Priority Species

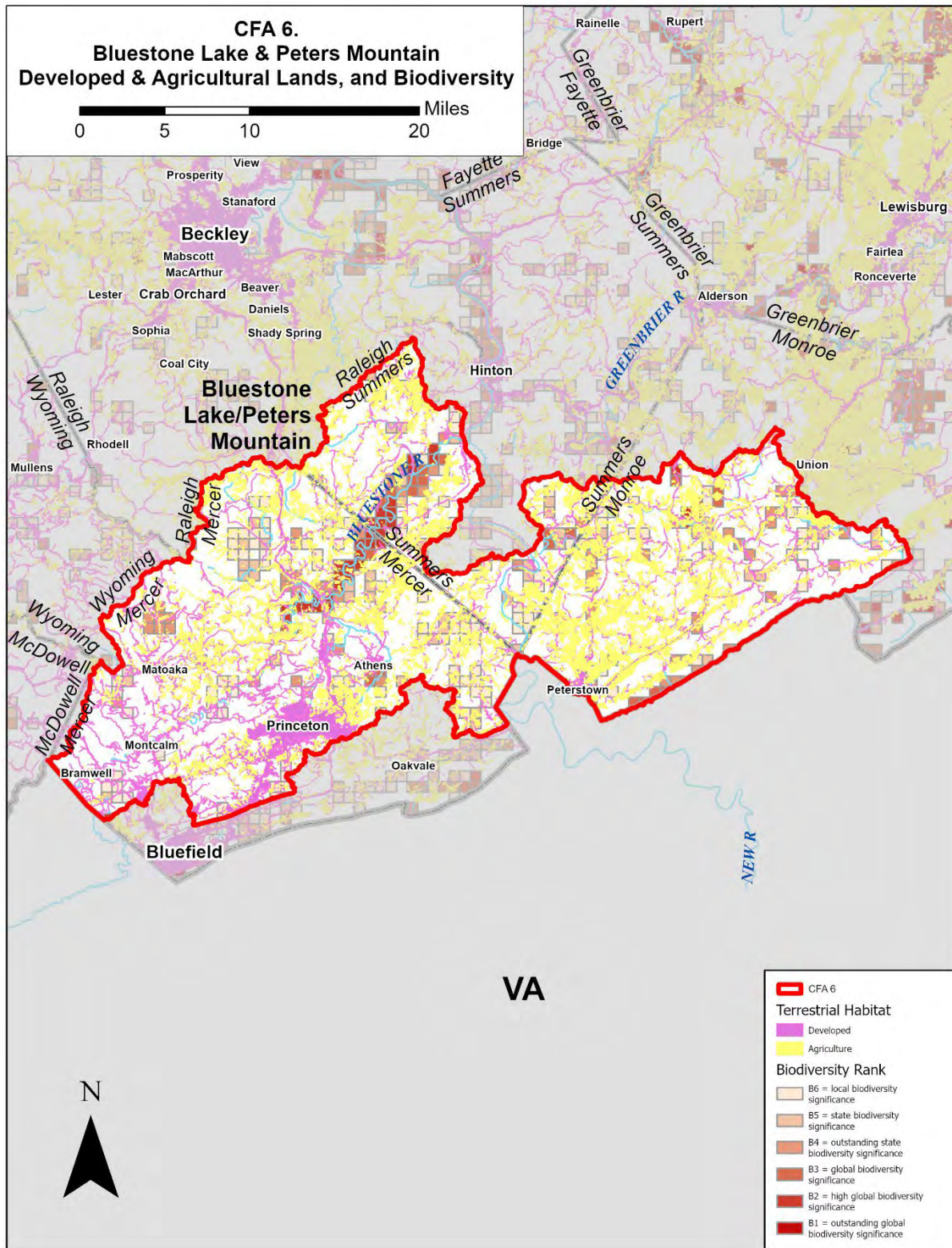
Agricultural lands including pastures and hayfields, grasslands and shrublands, along with adjacent areas of natural vegetation in and around adjacent forests and woodlots, hedgerows, fallow areas, ponds, wetlands and streams provide valuable habitat for several priority species in the CFA. Agricultural areas sometimes provide habitat that supports wildlife species dependent on specific vegetation types no longer present as part of a diverse forested landscape. For example, Loggerhead Shrike, Field Sparrow, Grasshopper Sparrow and Eastern Meadowlark rely on tall grass with scattered brush, small trees and shrubs that grow in hedgerows, field edges, abandoned or fallow fields. Eastern Whip-poor-will rely on open woodlands which often grow in and around agricultural areas. Chimney Swift and Barn Owl Species rely on structures in developed and agricultural areas.

Table 17 lists priority SGCN associated with agricultural and developed habitats in the CFA.

Table 17. Priority Species in Agricultural and Developed Habitats

Taxa	Scientific Name	Common Name
Birds	<i>Ammodramus savannarum</i>	Grasshopper Sparrow
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will
Birds	<i>Chaetura pelagica</i>	Chimney Swift
Birds	<i>Falco sparverius</i>	American Kestrel
Birds	<i>Lanius ludovicianus migrans</i>	Loggerhead Shrike
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Spizella pusilla</i>	Field Sparrow
Birds	<i>Sturnella magna</i>	Eastern Meadowlark
Birds	<i>Tyto alba</i>	Barn Owl
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle

Map 14. Developed & Agricultural Lands and Biodiversity



Habitat Stresses and Conservation Actions

The conversion of farmland for residential and commercial development often reduces valuable habitat for wildlife, especially grassland birds. In addition, modern farming practices have resulted in the intensification of mechanized farming practices and the expansion of areas cleared for crop agriculture. Consequently, much natural vegetation providing wildlife habitat in grasslands, wetlands, fallow areas, riparian corridors, hedgerows and forest edges has been cleared. Table 26 lists stresses to wildlife habitat in agricultural areas and conservation actions to address them. In addition to these habitat stresses, Barn Owls suffer from poisoning by rodenticide, road collisions and demolition of old barns and other structures they occupy. American Kestrels are stressed by insufficient nest sites and nest site competition from European Starlings. Chimney Swifts suffer from chimney capping and the illegal removal of birds and their nests. Many grassland birds suffer nest destruction from mowing. Eastern Whip-poor-will are stressed by road collision mortality, and American Woodcock populations are impacted by hunting, particularly if the decline in migrants increases hunting pressure on the breeding population. Eastern Box Turtle are threatened by road collisions, disease, and illegal collection.

Table 18. Habitat Stresses and Conservation Actions in Agricultural & Developed Habitats:

Habitat Stress	Conservation Action
Conversion to crop agriculture and clean farming practices: loss of grassland, woody vegetation, pollinator habitat, bird breeding and roosting sites	Retain or plant shrubs, hedgerows and hawthorns in pastures, pollinator habitat and grasslands
Loss of early-successional habitat in and around agricultural land, overgrazing	Retain early-successional habitat with healthy grasses and forbs, monitor grazing impacts and prevent overgrazing
Chimney capping	Uncap chimneys, install towers for chimney swifts, retain hollow snags and logs
Barn owl poisoning from rodenticides	Outreach to landowners to reduce rodenticides
Insufficient American kestrel and barn owl nest microhabitat	Install and monitor nest boxes, create and retain snags
Water quality degradation around karst, caves springs and streams	Control livestock access, protect water quality, riparian buffers and natural vegetation around caves and sinkholes

Climate Change and Habitat Resilience

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.

Many wildlife species associated with agricultural and developed lands rely on grassland and pasture, fallow fields, floodplain and riparian corridors, streams, wetlands and areas of natural vegetation around field and forest edges. In agricultural settings, 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. Riparian forests may be vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation in streams. Drought may stress streams and aquatic life, as well as plants, and increase their susceptibility to pests and pathogens. Warming temperatures and increased storm disturbances may enable nonnative invasive plant species to outcompete native species.

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 streams, wetlands, riparian areas and forest edges 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 27 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 19. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

Climate Stress:	Habitat Resilience Action:
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 20. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
<p>Habitat Protection:</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition 	<ul style="list-style-type: none"> • County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Habitat Protection</p> <ul style="list-style-type: none"> • Cost-Share Programs 	<ul style="list-style-type: none"> • USDA FSA • WVCA and ECD 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Reduce clearing of native vegetation such as hawthorns in pastures; retain or plant hedgerows and areas with native vegetation</p>	<ul style="list-style-type: none"> • USDA FSA & NRCS • USFWS Partners for Fish and Wildlife Program • WVCA and ECD 	<ul style="list-style-type: none"> • Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats

Action	Partners	Effectiveness Measures
Create and maintain pollinator habitat and nectar resources, including diverse native and non-invasive flowering forbs, shrubs, trees, larval host plants and undisturbed nesting and overwintering areas along field edges, woodlots, water bodies, roads, on fallow fields and other appropriate sites.	<ul style="list-style-type: none"> • Consulting Foresters • Public Land Managers • USDA NRCS • USFWS Partners for Wildlife Program • WVDOH 	<ul style="list-style-type: none"> • Acres or linear feet of pollinator habitat created or maintained • 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	<ul style="list-style-type: none"> • Public Land Managers • Trout Unlimited • USDA FSA & NRCS • WVCA and ECD 	<ul style="list-style-type: none"> • Acres of habitat restored • Abundance & distribution of priority species and habitats
Create early-successional habitat	<ul style="list-style-type: none"> • Public Land Managers • USDA NRCS • WVCA and ECD 	<ul style="list-style-type: none"> • Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats
Prevent conversion of grasslands to croplands	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of grasslands planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Adjust timing and interval of hay harvest	<ul style="list-style-type: none"> • USDA FSA • WVCA and ECD 	<ul style="list-style-type: none"> • Acres of hayfields under adjusted harvest schedule • Change in abundance, diversity and distribution of priority species and habitats
Monitoring and careful treatment of nonnative invasive species, replace with native plantings	<ul style="list-style-type: none"> • USDA FSA & NRCS • WVCA and ECD • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat maintained or restored • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Control livestock access, protect water quality, riparian buffers and natural vegetation around streams, caves and sinkholes	<ul style="list-style-type: none"> • USDA FSA & NRCS • USFWS Partners for Wildlife Program • WVCA and ECD • WVU Extension 	<ul style="list-style-type: none"> • Acres of habitat maintained or restored • Before and after comparison: abundance and diversity of priority species
Outreach to landowners to reduce rodenticides for barn owls	<ul style="list-style-type: none"> • Landowners and volunteer groups • WVU Extension 	<ul style="list-style-type: none"> • # of landowners engaged • Reduction in use of rodenticides • Change in abundance, diversity and distribution of priority species
Landowner outreach, uncapping chimneys, install swift towers	<ul style="list-style-type: none"> • Landowners and volunteer groups • WVU Extension 	<ul style="list-style-type: none"> • # chimneys uncapped • # swift towers installed • Change in abundance, diversity and distribution of chimney swifts
USDA NRCS Climate Smart Agricultural practices and plans to adapt farm practices, infrastructure and land uses to changing conditions	<ul style="list-style-type: none"> • Public Land Managers • USDA FSA & NRCS 	<ul style="list-style-type: none"> • # practices or acres adapted • Change in abundance, diversity and distribution of priority species
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> • Mountain RCD • Public Land Managers • USDA NRCS • WVDEP, WVCA and Conservation Districts • WVDNR • WVDNR, WVDOF • WVU Extension 	<ul style="list-style-type: none"> • # Landowners engaged • # Landowners implementing actions

Human Benefits

Actions to restore and protect wildlife habitat within agricultural areas and developed lands may provide benefits including erosion control and improved water quality, improved hunting, fishing and recreational opportunities, and conservation of native pollinators for crop production.

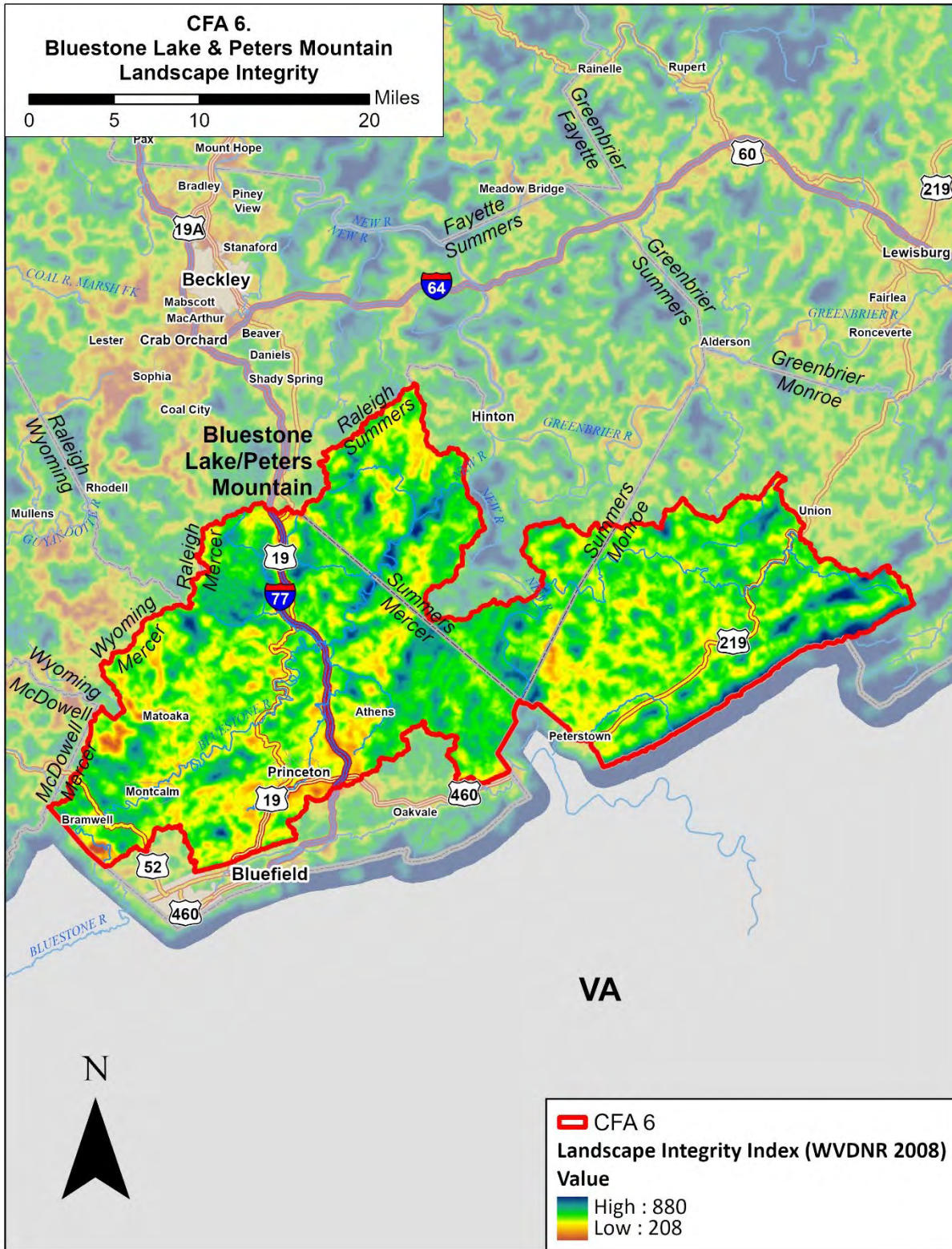
Landscape Resilience and Connectivity

The conservation and resilience actions described previously in this action 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 they 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).

Wildlife conservation in 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 1000 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. The map on the subsequent page illustrates several small areas of high landscape integrity in the CFA, along Peters Mountain, the northern end of the Bluestone River, the New River, and the area around Cabin Creek and Pipestem State Park. High integrity landscapes are conservation priorities in this CFA.

Map 15. Landscape Integrity



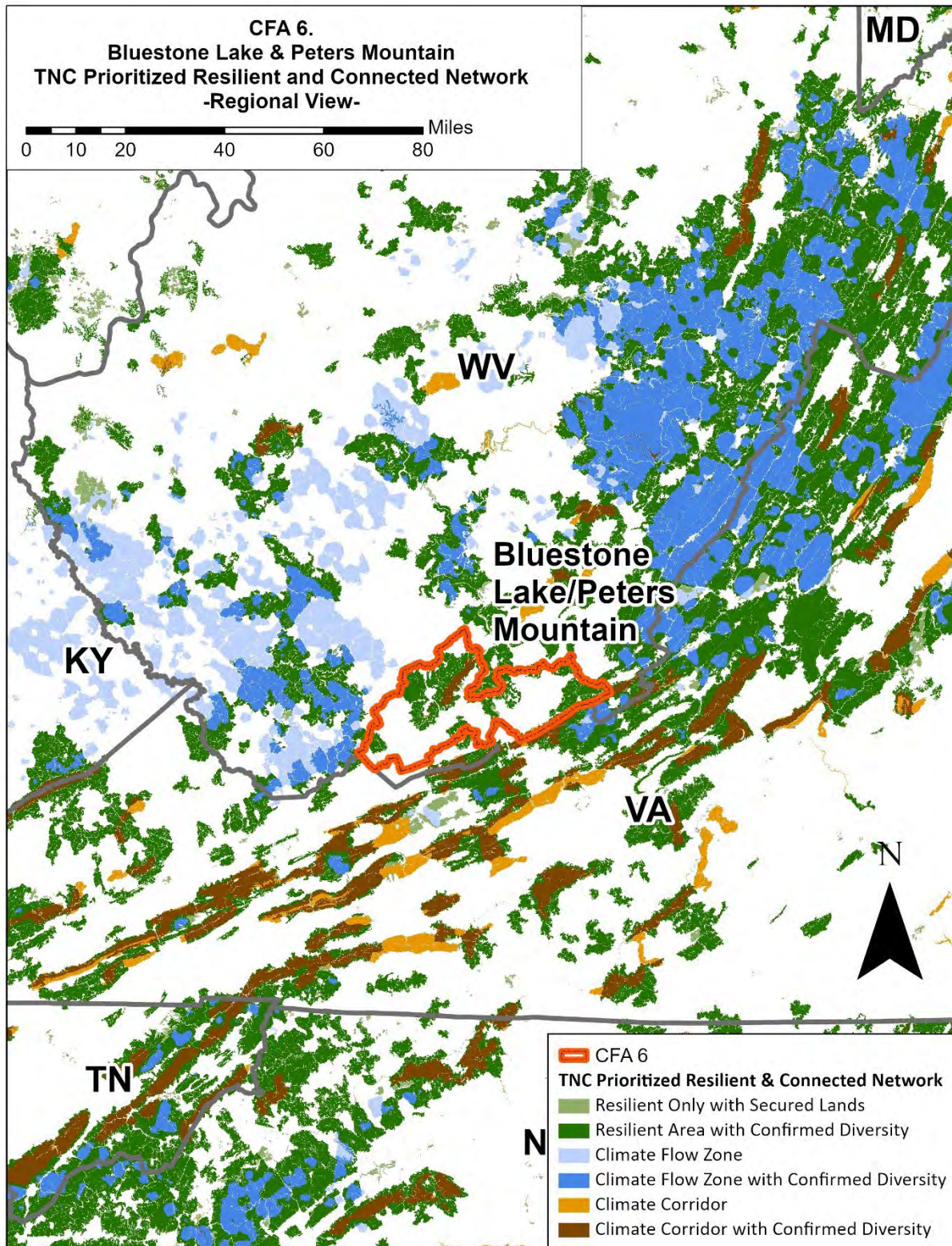
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic and elevation diversity that offer a range of habitat types and microclimates for species and ecosystems to adapt to climate change, along with high landscape integrity or local connectedness where species could move locally and disperse in response to climate change, and where natural processes like fire and floods could continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the movement or 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. Lastly the team developed models that integrated landscape resilience, connectivity and the flow of species and populations across the landscape to identify 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. To identify the subset of places most essential for sustaining biodiversity in a changing climate and aligned to the natural flow patterns across the region, the team then identified 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:

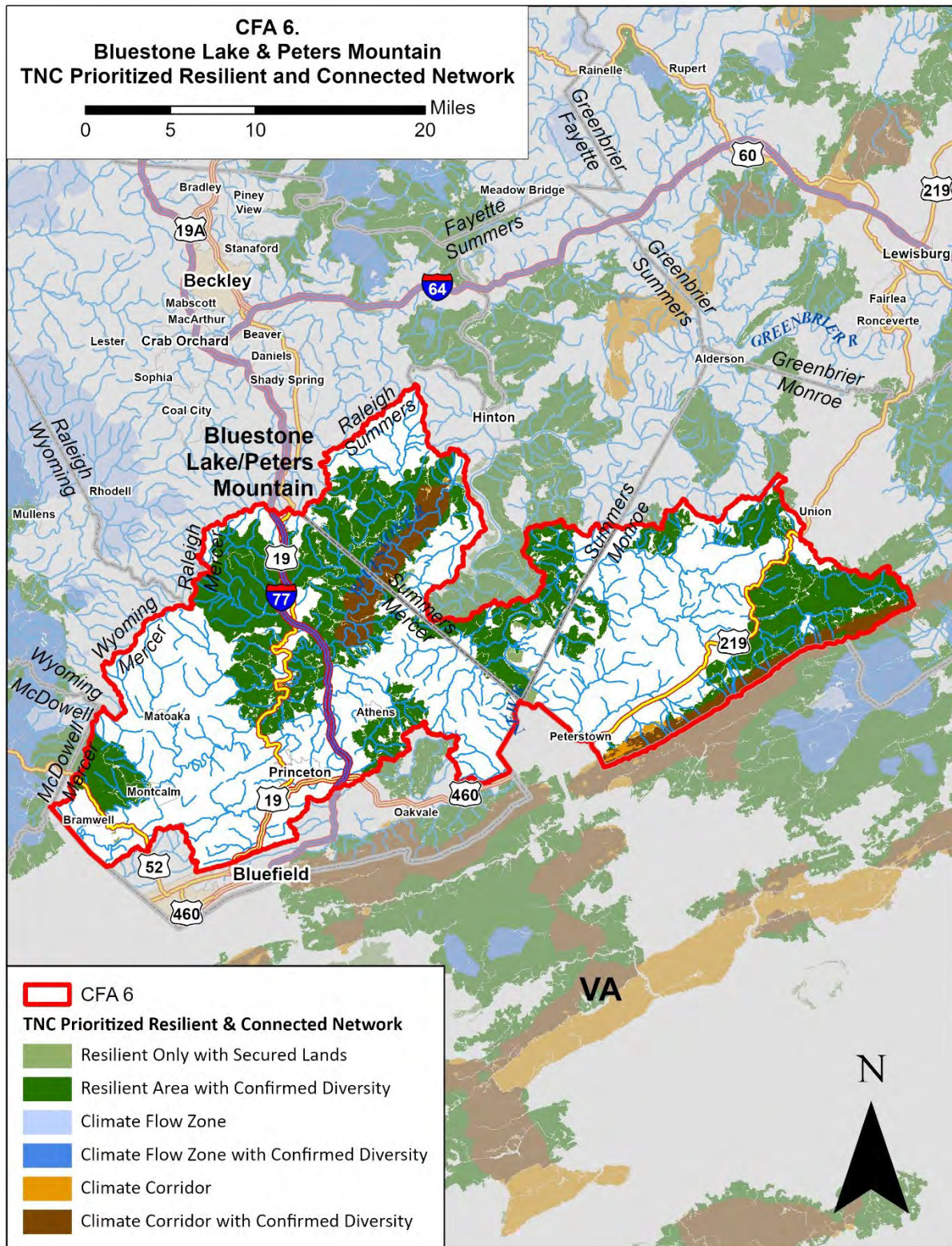
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes 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 intact forest patches and areas of high integrity

Map 16 illustrates that the resilient, connected landscapes around high integrity landscapes in the CFA forms part of a hub of large forest blocks, resilient landscapes and flow zones that link the narrower climate corridors both north into Maryland and Pennsylvania and south into Virginia. The resilient, connected landscapes in this CFA are critical to the species adapting to climate change within the larger network across the Eastern United States.

Map 16. Priority Resilient and Connected Network: Regional View



Map 17. Priority Resilient and Connected Network – Detailed View



Map 17 provides a detailed view of the resilient, connected landscapes in the Bluestone Lake and Peters Mountain CFA. There is a climate corridor spanning the Virginia border along Peters Mountain, an important migratory pathway, and another along the northern portion of the Bluestone River. Several larger resilient lands with confirmed biological diversity include the larger, intact forest patches along the Bluestone River, New River and Peters Mountain. Protecting and maintaining these areas of high landscape integrity and the resilient areas and climate corridors 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
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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
<p>Protection of Resilient, Connected Landscapes and migratory corridors</p> <ul style="list-style-type: none"> • Conservation Easements • Land Acquisition 	<ul style="list-style-type: none"> • County Farmland Protection Boards • OHCF, TCF, TNC, WVLT • USDA NRCS • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
<p>Develop and Implement Plans to Manage Resilient Connected Landscapes</p> <ul style="list-style-type: none"> • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs 	<ul style="list-style-type: none"> • AFF, AMJV, NWTF, RGS, TNC • AFTS, FSC, SFI • AMJV • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WV DNR, WVDOF 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats

Conclusion

Habitat Conservation Priorities

This action plan lists priority species and rare plant communities targeted for conservation action on public and private land and within each major habitat type. The major habitat types include forests and woodlands, 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 for conservation action.

- Large, intact forest patches, including interior forest habitat
- Early-successional forest habitat
- Small areas of unique, geologically derived habitat including:
 - Acidic rock outcrops, cliffs and talus
 - Calcareous cliffs and talus
- Karst areas, their watersheds, and a buffer area surrounding a biologically significant cave
- Mussel streams, small stream riparian and river floodplain habitats
- Riparian corridors, wetlands, grasslands and fallow fields, field borders and other areas of natural and woody vegetation within and around agricultural lands
- High integrity, resilient and connected landscapes and migratory corridors.

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

Integration of Conservation Actions

Integration of conservation actions within the above priority habitats, such as projects to improve mussel stream habitat by improving wastewater treatment, enlarging stream crossings and planting riparian stream buffers may benefit multiple plant communities and wildlife species. Coordinating actions across multiple habitats, such as protecting large patches of diverse forest habitats that also include rare shale barrens, rock outcrops or cliff and talus habitats, or improving water quality and planting riparian corridors in karst landscapes or cave watersheds, 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. Protecting areas of high landscape integrity as well as the regional network of resilient lands, climate corridors and flow zones is also critical for enabling wildlife species to adapt to changing conditions and shift across the landscape.

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

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Amphibians	<i>Ambystoma jeffersonianum</i>	Jefferson Salamander	S2	G4		
Amphibians	<i>Aneides aeneus</i>	Green Salamander	S3	G3G4		
Amphibians	<i>Desmognathus kanawah</i>	Black-bellied Salamander	S3	G5		
Amphibians	<i>Desmognathus welteri</i>	Black Mountain Salamander	S2	G4		
Amphibians	<i>Eurycea lucifuga</i>	Cave Salamander	S3	G5		
Amphibians	<i>Plethodon kentucki</i>	Cumberland Plateau Salamander	S3	G4		
Amphibians	<i>Plethodon wehrlei</i>	Wehrle's Salamander	S4	G4		
Amphibians	<i>Pseudotriton montanus diastictus</i>	Midland Mud Salamander	S1	G5T5		
Amphibians	<i>Pseudotriton ruber ruber</i>	(northern) Red Salamander	S3	G5		
Birds	<i>Ammodramus savannarum</i>	Grasshopper Sparrow	S3B	G5		
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	S3B	G5		Conserv
Birds	<i>Ardea herodias</i>	Great Blue Heron	S3B,S4N	G5		
Birds	<i>Bonasa umbellus</i>	Ruffed Grouse	S3B,S3N	G5		
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk	S3B	G5		
Birds	<i>Butorides virescens</i>	Green Heron	S3B	G5		
Birds	<i>Chaetura pelagica</i>	Chimney Swift	S3B	G5		
Birds	<i>Colinus virginianus</i>	Northern Bobwhite	S1B, S1N	G5		
Birds	<i>Falco sparverius</i>	American Kestrel	S3B	G5		
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler	S3B	G5		
Birds	<i>Haliaeetus leucocephalus</i>	Bald Eagle	S3B,S3N	G5		
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler	S3B	G5		
Birds	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5		Conserv
Birds	<i>Lanius ludovicianus migrans</i>	Migrant Loggerhead Shrike	S1B,S1N	G4T3Q		
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush	S3B	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Birds	<i>Petrochelidon pyrrhonota</i>	Cliff Swallow	S3B	G5		
Birds	<i>Piranga rubra</i>	Summer Tanager	S3B	G5		
Birds	<i>Scolopax minor</i>	American Woodcock	S3B	G5		
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4		Conserv
Birds	<i>Setophaga discolor</i>	Prairie Warbler	S3B	G5		
Birds	<i>Spizella pusilla</i>	Field Sparrow	S3B	G5		
Birds	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5		
Birds	<i>Tyto alba</i>	Barn Owl	S2B,S2N	G5		
Birds	<i>Vermivora chrysoptera</i>	Golden-winged Warbler	S1B	G4		Conserv
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5		
Butterflies and Moths	<i>Calephelis borealis</i>	Northern Metalmark	S2	G3G4		
Butterflies and Moths	<i>Celastrina serotina</i>	Cherry Gall Azure	SNR	G5		
Butterflies and Moths	<i>Erora laeta</i>	Early Hairstreak	S2	GU		
Butterflies and Moths	<i>Erynnis martialis</i>	Mottled Duskywing	S3	G3		
Butterflies and Moths	<i>Glaucopsyche l. lygdamus</i>	Silvery Blue	S4	G5T3T4		
Butterflies and Moths	<i>Speyeria diana</i>	Diana Fritillary	S2S3	G3G4		
Cave Invertebrates	<i>Bathyphantes weyeri</i>	A Cave Spider	S3	G4		
Cave Invertebrates	<i>Caecidotea holsingeri</i>	Greenbrier Valley Cave Isopod	S3	G5		
Cave Invertebrates	<i>Crangonyx sp. 2</i>	An Amphipod	S2	G2		
Cave Invertebrates	<i>Phanetta subterranea</i>	A Spider	S3	G5		
Cave Invertebrates	<i>Poecilophysis weyerensis</i>	A Cave Mite	S1	G3?		
Cave Invertebrates	<i>Porrhomma cavernicola</i>	Appalachian Cave Spider	S2	G5		
Cave Invertebrates	<i>Pseudanopthalmus fuscus</i>	A Cave Beetle	S2	G4		
Cave Invertebrates	<i>Pseudanopthalmus orthosulcatus</i>	A Cave Beetle	S1	G1		
Cave Invertebrates	<i>Pseudosinella gisini gisini</i>	A Cave Springtail	S3	G3G4T3		
Cave Invertebrates	<i>Pseudosinella testa</i>	Shelled Cave Springtail	S1	G2G3		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Cave Invertebrates	<i>Rhagidia varia</i>	A Cave Mite	S3	G5		
Cave Invertebrates	<i>Sinella hoffmani</i>	Hoffman's Springtail	S3	G5		
Cave Invertebrates	<i>Stygobromus emarginatus</i>	Greenbrier Cave Amphipod	S3	G3G4		
Cave Invertebrates	<i>Stygobromus mackini</i>	Southwestern Virginia Cave Amphipod	S2	G5		
Cave Invertebrates	<i>Stygobromus spinatus</i>	Spring Cave Amphipod	S2	G2G3		
Cave Invertebrates	<i>Zygonopus packardi</i>	Packard's Blind Cave Millipede	S2	G4		
Crayfish	<i>Cambarus chasmodactylus</i>	New River Crayfish	S3	G4		
Crayfish	<i>Cambarus veteranus</i>	"guyandotte River" Crayfish	S1	G1		
Dragonflies and Damselflies	<i>Aeshna tuberculifera</i>	Black-tipped Darner	S3	G4		
Dragonflies and Damselflies	<i>Ladona deplanata</i>	Blue Corporal	S3	G5		
Dragonflies and Damselflies	<i>Lestes inaequalis</i>	Elegant Spreadwing	S3	G5		
Dragonflies and Damselflies	<i>Ophiogomphus incurvatus alleghaniensis</i>	Appalachian Snaketail	SH	G3T2T3		
Dragonflies and Damselflies	<i>Ophiogomphus rupinsulensis</i>	Rusty Snaketail	S2	G5		
Dragonflies and Damselflies	<i>Somatochlora elongata</i>	Ski-tipped Emerald	S3	G5		
Dragonflies and Damselflies	<i>Somatochlora linearis</i>	Mocha Emerald	S3	G5		
Dragonflies and Damselflies	<i>Tachopteryx thoreyi</i>	Gray Petaltail	S3	G4		
Fish	<i>Cottus kanawhae</i>	Kanawha Sculpin	S2	G4		
Fish	<i>Cottus sp. 1</i>	Bluestone Sculpin	S1	G2		Science
Fish	<i>Etheostoma osburni</i>	Candy Darter	S1	G3	E	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Fish	<i>Exoglossum laurae</i>	Tonguetied Minnow	S2	G4		
Fish	<i>Lythrurus ardens</i>	Rosefin Shiner	S1	G5		
Fish	<i>Notropis scabriceps</i>	New River Shiner	S2	G4		
Fish	<i>Phenacobius teretulus</i>	Kanawha Minnow	S1	G3G4		
Mammals	<i>Cryptotis parva</i>	Least Shrew	S2	G5		
Mammals	<i>Lasiurus borealis</i>	Eastern Red Bat	S4	G5		
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat	S1	G3		
Mammals	<i>Myotis lucifugus</i>	Little Brown Myotis	S2*	G3		
Mammals	<i>Myotis septentrionalis</i>	Northern Myotis	S2*	G2G3	T	
Mammals	<i>Myotis sodalis</i>	Indiana Bat	S1	G2	E	
Mammals	<i>Neotoma magister</i>	Allegheny Woodrat	S3	G3G4		
Mammals	<i>Ochrotomys nuttalli</i>	Golden Mouse	S2	G5		
Mammals	<i>Sorex hoyi winnemana</i>	Southern Pygmy Shrew	S2S3	G5T4		
Mammals	<i>Sylvilagus obscurus</i>	Appalachian Cottontail	S2	G4		
Mammals	<i>Zapus hudsonius</i>	Meadow Jumping Mouse	S3	G5		
Mussels	<i>Actinonaias ligamentina</i>	Mucket	S3	G5		
Mussels	<i>Alasmidonta marginata</i>	Elktoe	S1	G4		
Mussels	<i>Cyclonaias tuberculata</i>	Purple Wartyback	S1	G5		
Mussels	<i>Elliptio dilatata</i>	Spike	S3	G5		
Mussels	<i>Lampsilis cardium</i>	Plain Pocketbook	S3	G5		
Mussels	<i>Lampsilis fasciola</i>	Wavy-rayed Lampmussel	S3	G5		
Mussels	<i>Pyganodon grandis</i>	Giant Floater	S3	G5		
Mussels	<i>Toxolasma parvus</i>	Lilliput	S2	G5		
Mussels	<i>Tritogonia verrucosa</i>	Pistolgrip	S3	G4G5		
Mussels	<i>Villosa iris</i>	Rainbow	S2	G5Q		
Plants	<i>Adlumia fungosa</i>	Allegheny-vine	S2?	G4		
Plants	<i>Agrimonia microcarpa</i>	Small-fruit Groovebur	S1	G5		
Plants	<i>Allium oxyphilum</i>	Nodding Wild Onion	S2	G2Q		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	<i>Amorpha fruticosa</i>	Tall Indigobush	S2S3	G5		
Plants	<i>Anemone canadensis</i>	Roundleaf Thimbleweed	S1	G5		
Plants	<i>Anemone quinquefolia</i> var. <i>minima</i>	Dwarf Anemone	S2	G5T3		
Plants	<i>Berberis canadensis</i>	American Barberry	S1	G3		
Plants	<i>Calycanthus floridus</i> var. <i>glaucus</i>	Carolina Allspice, Strawberry-shrub	SH	G5T5		
Plants	<i>Cardamine flagellifera</i> var. <i>flagellifera</i>	Bittercress	S2	G3		
Plants	<i>Carex aggregata</i>	Glomerate Sedge	S2	G5		
Plants	<i>Carex bromoides</i> ssp. <i>bromoides</i>	Brome-like Sedge	S3	G5T5		
Plants	<i>Carex emoryi</i>	Emory's Sedge	S2	G5		
Plants	<i>Carex hirtifolia</i>	Pubescent Sedge	S3	G5		
Plants	<i>Carex molesta</i>	Troublesome Sedge	S3	G4		
Plants	<i>Carex normalis</i>	Greater Straw Sedge	S3	G5		
Plants	<i>Carex planispicata</i>	Flat-spiked Sedge	S2	G4Q		
Plants	<i>Carex typhina</i>	Cattail Sedge	S2	G5		
Plants	<i>Cheilanthes tomentosa</i>	Woolly Lipfern	S1	G5		
Plants	<i>Coreopsis pubescens</i>	Star Tickseed	S2	G5?		
Plants	<i>Cymophyllus fraserianus</i>	Fraser's Sedge	S3	G4		
Plants	<i>Delphinium exaltatum</i>	Tall Larkspur	S2	G3		
Plants	<i>Eleocharis palustris</i>	Marsh Spikerush	S3	G5		
Plants	<i>Goodyera repens</i>	Dwarf Rattlesnake-plantain	S1S2	G5		
Plants	<i>Hasteola suaveolens</i>	False Indian-plantain	S3	G4		
Plants	<i>Helianthus laevigatus</i>	Smooth Sunflower	S2	G4		
Plants	<i>Heuchera americana</i> var. <i>hispida</i>	Rough Alumroot, Rough Heuchera	S2	G5T3?		
Plants	<i>Juglans cinerea</i>	Butternut	S3	G4		
Plants	<i>Juncus dichotomus</i>	Forked Rush	S1	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	<i>Lemna valdiviana</i>	Pale Duckweed	S3	G5		
Plants	<i>Lilium michauxii</i>	Carolina Lily	S1	G4G5		
Plants	<i>Listera smallii</i>	Kidneyleaf Twayblade	S2	G4		
Plants	<i>Lonicera canadensis</i>	Fly Honeysuckle	S2	G5		
Plants	<i>Lygodium palmatum</i>	American Climbing Fern	S3	G4		
Plants	<i>Lysimachia quadriflora</i>	Four-flower Loosestrife	S1	G5?		
Plants	<i>Lysimachia tona</i>	Southern Loosestrife	SH	G4		
Plants	<i>Maianthemum stellatum</i>	Starflower False Solomon's-seal	S2	G5		
Plants	<i>Monarda fistulosa</i> ssp. <i>brevis</i>	Smoke Hole Bergamot	S1	G5T1		
Plants	<i>Myosotis macrosperma</i>	Large-seed Forget-me-not	S3	G5		
Plants	<i>Panicum flexile</i>	Wiry Panicgrass	S1	G5		
Plants	<i>Paxistima canbyi</i>	Canby's Mountain-lover	S2	G2		
Plants	<i>Pellaea glabella</i> ssp. <i>glabella</i>	Smooth Cliffbrake	S2	G5T5		
Plants	<i>Phlox buckleyi</i>	Swordleaf Phlox, Shale Barren Phlox	S2	G2		
Plants	<i>Piptatherum racemosum</i>	Black-seed Mountain Ricegrass	S2	G5		
Plants	<i>Platanthera ciliaris</i>	Yellow-fringe Orchid	S3	G5		
Plants	<i>Prunus alleghaniensis</i> var. <i>alleghaniensis</i>	Allegheny Plum	S3	G4T4		
Plants	<i>Quercus shumardii</i>	Shumard Oak	S2	G5		
Plants	<i>Ranunculus sceleratus</i> var. <i>sceleratus</i>	Cursed Crowfoot	S2	G5T5		
Plants	<i>Rhynchospora recognita</i>	Beaked Rush	S2	G5?		
Plants	<i>Ribes lacustre</i>	Bristly Black Currant	S2	G5		
Plants	<i>Scutellaria saxatilis</i>	Rock Skullcap	S2	G3		
Plants	<i>Silene nivea</i>	Snowy Catchfly	S1	G4?		
Plants	<i>Solidago arguta</i> var. <i>harrisii</i>	Shalebarren Goldenrod	S3	G5T4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	<i>Solidago faucibus</i>	Gorge Goldenrod	S1	G2G4		
Plants	<i>Spiraea virginiana</i>	Virginia Spiraea	S1	G2	T	
Plants	<i>Stachys tenuifolia</i>	Smooth Hedge-nettle	S3	G5		
Plants	<i>Stenanthium gramineum</i> var. <i>gramineum</i>	Featherbells	S2S3	G4G5T3T5		
Plants	<i>Taenidia montana</i>	Mountain-pimpernel	S3	G3		
Plants	<i>Taxus canadensis</i>	Canada Yew	S2S3	G5		
Plants	<i>Thuja occidentalis</i>	Northern White-cedar	S2	G5		
Plants	<i>Tortula ammonsiana</i>	Ammons' Twist Moss	S1	G1		
Plants	<i>Trifolium reflexum</i>	Buffalo Clover	S1	G3G4		
Plants	<i>Viburnum rafinesquianum</i>	Downy Arrow-wood	S2	G5		
Plants	<i>Vitis rupestris</i>	Sand Grape	S2	G3		
Plants	<i>Woodsia appalachiana</i>	Allegheny Cliff Fern	S2	G4		
Plants	<i>Xyris torta</i>	Slender Yellow-eyed-grass	S2	G5		
Reptiles	<i>Agkistrodon contortrix mokasen</i>	Northern Copperhead	S5	G5T5		
Reptiles	<i>Carphophis amoenus</i>	Wormsnake	S3	G5		
Reptiles	<i>Coluber constrictor constrictor</i>	Northern Black Racer	SNR	G5T5		
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4		
Reptiles	<i>Heterodon platirhinos</i>	Eastern Hog-nosed Snake	S2	G5		
Reptiles	<i>Opheodrys aestivus</i>	Rough Greensnake	S2	G5		
Reptiles	<i>Pseudemys rubriventris</i>	Northern Red-bellied Cooter	S2	G5		
Reptiles	<i>Regina septemvittata</i>	Queen Snake	S4	G5		
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	S5	G5T5		
Snails	<i>Anguispira mordax</i>	Appalachian Tigersnail	S2	G4		
Snails	<i>Anguispira strongyloides</i>	Southeastern Tigersnail	S2	G5		
Snails	<i>Euchemotrema leai</i>	Lowland Pillsnail	S3	G5		
Snails	<i>Fontigens tartarea</i>	Organ Cavesnail	S2	G2		
Snails	<i>Hendersonia occulta</i>	Cherrystone Drop	S3	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Snails	<i>Inflectarius inflectus</i>	Shagreen	S2	G5		
Snails	<i>Mesodon mitchellianus</i>	Sealed Globelet	S3	G4		
Snails	<i>Mesodon normalis</i>	Grand Globe	S1	G5		
Snails	<i>Mesodon normalis</i>	Grand Globe	S1	G5		
Snails	<i>Paravitrea reesei</i>	Round Supercoil	S2	G3		
Snails	<i>Stenotrema barbatum</i>	Bristled Slitmouth	S3	G5		
Snails	<i>Stenotrema barbatum</i>	Bristled Slitmouth	S3	G5		
Snails	<i>Stenotrema edwardsi</i>	Ridge-and-valley Slitmouth	S3	G4G5		
Snails	<i>Stenotrema macgregori</i>	Fraudulent Slitmouth	S2	GNR		
Snails	<i>Stenotrema macgregori</i>	Fraudulent Slitmouth	S2	GNR		
Snails	<i>Triodopsis juxtidentis robiniae</i>	Brush Creek Threetooth	S5T1	GNR		
Snails	<i>Triodopsis vulgata</i>	Dished Threetooth	S2	G5		
Snails	<i>Vallonia perspectiva</i>	Thin-lip Vallonia	S3	G4G5		
Snails	<i>Ventridens acerra</i>	Glossy Dome	S2	G4		
Snails	<i>Ventridens coelaxis</i>	Bidentate Dome	S1	G3		
Snails	<i>Ventridens collisella</i>	Sculptured Dome	S3	G4G5		
Snails	<i>Ventridens lawae</i>	Rounded Dome	SH	G4		
Snails	<i>Ventridens virginicus</i>	Split-tooth Dome	S3	G4		
Snails	<i>Zonitoides elliotti</i>	Green Dome	S2	G4		
Tiger Beetles	<i>Cicindela ancocisconensis</i>	Appalachian Tiger Beetle	S3	G3		
Tiger Beetles	<i>Cicindela unipunctata</i>	A Tiger Beetle	S3	G4G5		

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

Federal Status: T= Threatened, E = Endangered.

USFWS Priority At Risk (2021): Conserv = need management attention, Science = need more research.

Appendix 2. Priority SGCN, Known Stresses and Actions

Forests and Woodlands		
Common Name	Local Stress	Action
American Woodcock	<ul style="list-style-type: none"> • Consumptive use if decline in migrant woodcocks increases hunting pressure in breeding population 	<ul style="list-style-type: none"> • Adjust USFWS regulatory package • Adjust state hunting regulations if needed
Blue-winged Warbler	<ul style="list-style-type: none"> • Forest maturation, incompatible forest structure • Habitat loss on wintering grounds 	<ul style="list-style-type: none"> • Implement BMPs on public and private lands
Cave Salamander	<ul style="list-style-type: none"> • Habitat degradation 	<ul style="list-style-type: none"> • Restrict cave access when necessary • Maintain appropriate forested buffers around caves and rocky outcrops
Cerulean Warbler	<ul style="list-style-type: none"> • Forest fragmentation and loss from residential development and industrial activities • Incompatible forest structure 	<ul style="list-style-type: none"> • Implement BMPs on public and private lands
Cumberland Plateau Salamander	<ul style="list-style-type: none"> • Habitat degradation 	<ul style="list-style-type: none"> • Implement forestry BMPs
Diana Fritillary	<ul style="list-style-type: none"> • Habitat loss from mineral extractions especially surface coal mining • Loss of nectar resources from mowing and deer browse 	<ul style="list-style-type: none"> • Improve management of surface coal mining • Encourage reduced mowing and other actions to propagate abundant native nectar sources • Reduce deer numbers through hunting and special seasons
Early Hairstreak	<ul style="list-style-type: none"> • Survival of abundant and fruiting stands on American beech (<i>Fagus americana</i>) 	<ul style="list-style-type: none"> • Avoid disturbance of mature beech stands • Outreach to landowners about new protocols to improve the health of beech stands that are impacted or vulnerable to beech canker fungus

Forests and Woodlands		
Common Name	Local Stress	Action
Eastern Box Turtle	<ul style="list-style-type: none"> • Illegal collection • Road mortality • Disease 	<ul style="list-style-type: none"> • Landowner outreach • Road signage around wildlife corridors
Eastern Whip-poor-will	<ul style="list-style-type: none"> • Forest maturation. • Understory habitat degradation. • Deer overabundance. 	<ul style="list-style-type: none"> • Develop and implement BMPs for timber management and prescribed fire • Reduce deer abundance.
Golden-winged Warbler	<ul style="list-style-type: none"> • Forest maturation, incompatible forest structure • Habitat loss on wintering grounds. 	<ul style="list-style-type: none"> • Implement BMPs on public and private lands
Green Salamander	<ul style="list-style-type: none"> • Habitat degradation 	<ul style="list-style-type: none"> • Buffer rocky outcrops and known occupied habitat
Midland Mud Salamander	<ul style="list-style-type: none"> • Habitat degradation • Water quality 	<ul style="list-style-type: none"> • Protection of springs and palustrine wetlands
Mottled Duskywing	<ul style="list-style-type: none"> • Loss of larval host (Ceanothus americanus - New Jersey tea) to deer browse • Loss of early-successional habitat where larval host can grow 	<ul style="list-style-type: none"> • Reduce white-tailed deer numbers with hunting, special seasons • Manage for early-successional habitat in appropriate area • Plant larval host and protect them from deer browse
Northern Metalmark	<ul style="list-style-type: none"> • Invasive plant species out-competing larval host (Packera obovata - roundleaf groundsel) • Deer browsing of larval host and nectar plants • Fragmentation of specialized, small and local colony sites 	<ul style="list-style-type: none"> • Develop and implement plans to control invasive plant species on public lands • Managed hunts on State Parks • Identify and avoid disturbance of SGCN in management plans for public lands
Prairie Warbler	<ul style="list-style-type: none"> • Insufficient habitat supply. 	<ul style="list-style-type: none"> • Forest and utility corridor management for shrubby habitats with minimal overstory
Ruffed Grouse	<ul style="list-style-type: none"> • Forest fragmentation. • Forest maturation. • Incompatible forest structure. 	<ul style="list-style-type: none"> • Create early-successional habitat through forest management within core forests.
Tiger Spiketail	<ul style="list-style-type: none"> • destruction of woodland seeps and streamlets 	<ul style="list-style-type: none"> • buffer woodland seeps and streams during timber harvest and forest clearing operations

Forests and Woodlands		
Common Name	Local Stress	Action
Timber Rattlesnake	<ul style="list-style-type: none"> • Illegal Collection • Persecution • Habitat Degradation 	<ul style="list-style-type: none"> • Outreach to spread awareness about illegal collection and reduce persecution • Follow forestry BMPs and avoid rocky areas used as denning and gestation habitat
Wood Thrush	<ul style="list-style-type: none"> • Forest fragmentation and loss. • Incompatible forest structure. • Deer overabundance. 	<ul style="list-style-type: none"> • Maintain and improve core forests with scattered openings and well-developed understories. • Reduce local deer populations.
Worm-eating Warbler	<ul style="list-style-type: none"> • Forest fragmentation and loss. • Incompatible forest structure. • Deer overabundance. • Fire suppression. 	<ul style="list-style-type: none"> • Maintain and improve core forests with scattered openings and well-developed understories. • Increase use of fire in adapted systems. • Reduce local deer populations.
Yellow-spotted Woodland Salamander	<ul style="list-style-type: none"> • Data Gaps 	<ul style="list-style-type: none"> • Determine current, especially on public lands • Collect baseline population data to better inform future management decisions.

Cave and Karst Habitats		
Common Name	Local Stress	Action
A beetle	<ul style="list-style-type: none"> • Land use changes (development / subdividing / home building) • Excessive grazing. 	<ul style="list-style-type: none"> • Inform landowner of species presence and significance.
A Cave Beetle	<ul style="list-style-type: none"> • Land use changes (Development, logging) • Excessive grazing (nutrient input, sedimentation) 	<ul style="list-style-type: none"> • Sinkhole fencing for cattle exclusion. • Provide information to landowners to guide proper future development. • Establish conservation easements on core species properties.

Cave and Karst Habitats		
Common Name	Local Stress	Action
Cave Salamander	<ul style="list-style-type: none"> Habitat degradation 	<ul style="list-style-type: none"> Maintain forested buffers around caves and springs Restore and protect water quality around caves and springs Restrict access.
Shelled Cave Springtail	<ul style="list-style-type: none"> Land use changes (development / subdividing / home building) Excessive grazing. 	<ul style="list-style-type: none"> Inform landowner of species presence and significance.

Agricultural and Developed Habitats		
Common Name	Local Stress	Action
American Kestrel	<ul style="list-style-type: none"> Insufficient nest sites Nest site competition from European Starling 	<ul style="list-style-type: none"> Implement nest box program and control starling populations in coordination with USDA-APHIS
American Woodcock	<ul style="list-style-type: none"> Consumptive use if decline in migrant woodcocks increases hunting pressure in breeding population 	<ul style="list-style-type: none"> Adjust USFWS regulatory package; adjust state hunting regulations if needed
Chimney Swift	<ul style="list-style-type: none"> 1. Breeding season chimney capping Illegal removal of breeding birds and nests 	<ul style="list-style-type: none"> Distribute management guidelines to landowners and industry
Eastern Box Turtle	<ul style="list-style-type: none"> Illegal collection Road mortality Disease 	<ul style="list-style-type: none"> Landowner outreach Road signage around wildlife corridors
Eastern Meadowlark	<ul style="list-style-type: none"> Nest destruction from mowing 	<ul style="list-style-type: none"> Adjust timing of mowing to boost nest success
Eastern Whip-poor-will	<ul style="list-style-type: none"> Forest maturation. Understory habitat degradation. Deer overabundance. Collision mortality 	<ul style="list-style-type: none"> Develop and implement BMPs for timber management and prescribed fire Reduce deer abundance. Install road signage where abundant
Field Sparrow	<ul style="list-style-type: none"> Nest destruction from mowing 	<ul style="list-style-type: none"> Landowner outreach Adjust timing of mowing

Agricultural and Developed Habitats		
Common Name	Local Stress	Action
Field Sparrow	<ul style="list-style-type: none"> Nest destruction from mowing/brush hogging 	<ul style="list-style-type: none"> Develop and distribute educational materials to private landowners
Grasshopper Sparrow	<ul style="list-style-type: none"> Nest destruction from mowing 	<ul style="list-style-type: none"> Adjust timing of mowing to boost nest success
Loggerhead Shrike	<ul style="list-style-type: none"> Loss of grasslands to development or succession/farmland abandonment Agricultural intensification and clean farming practices 	<ul style="list-style-type: none"> Work with private landowners and NRCS to create and maintain scattered shrubs in pastures, and hedgerows Increase grazing intensity at active sites

Aquatic, Floodplain and Riparian Habitats		
Common Name	Local Stress	Action
Appalachian Snaketail	<ul style="list-style-type: none"> Poor water quality in streams and rivers 	<ul style="list-style-type: none"> Reduce sedimentation from streamside activities Avoid herbicide use near streams, Improve residential septic systems
Black Mountain Salamander	<ul style="list-style-type: none"> Collection for fishing bait Disease Water Quality 	<ul style="list-style-type: none"> Angler outreach to discourage collection and use as bait Improve water quality
Black-bellied Salamander	<ul style="list-style-type: none"> Collection for fishing bait Disease Water Quality 	<ul style="list-style-type: none"> Angler outreach to discourage collection and use as bait Improve water quality
Diana Fritillary	<ul style="list-style-type: none"> Habitat loss from mineral extractions especially surface coal mining Loss of nectar resources from mowing and deer browse 	<ul style="list-style-type: none"> 1) Promote and collaborate on moving WV away from destructive surface coal mining; 2) Encourage reduced mowing and other actions to promote abundant native nectar sources; Reduce deer numbers through hunting and special seasons

Aquatic, Floodplain and Riparian Habitats		
Common Name	Local Stress	Action
Eastern Box Turtle	<ul style="list-style-type: none"> • Illegal collection • Road mortality • Disease 	<ul style="list-style-type: none"> • Landowner outreach • Road signage around wildlife corridors
Gray Petaltail	<ul style="list-style-type: none"> • Destruction of seeps and springs during road maintenance, possible flooding from severe rain events 	<ul style="list-style-type: none"> • Partner with DOH during road maintenance • Partner with DNR during management at Panther
Louisiana Waterthrush	<ul style="list-style-type: none"> • Water quality degradation from development, resource extraction, and runoff events. 	<ul style="list-style-type: none"> • Improve implementation and enforcement of mitigation measures • Improve water quality
Mocha Emerald	<ul style="list-style-type: none"> • Poor stream water quality due to pollutants, sedimentation 	<ul style="list-style-type: none"> • Avoid sedimentation by practicing good timber harvest BMPs, silt fence/filter strip during road maintenance, avoid chemical use near streams
Northern Metalmark	<ul style="list-style-type: none"> • Invasive plant species out-competing larval host (Packera obovata - roundleaf groundsel) • Deer browsing of larval host and nectar plants • Fragmentation of specialized, small and local colony sites 	<ul style="list-style-type: none"> • Develop and implement plans to control invasive plant species on public lands • Manage hunts on State Parks • Identify and avoid disturbance to SGCN in public land management plans
Rusty Snaketail	<ul style="list-style-type: none"> • Poor water quality in stream, agricultural pollutants 	<ul style="list-style-type: none"> • Reduce sedimentation from streamside activities • Avoid herbicide use near streams, • Improve residential septic systems
Ski-tipped Emerald	<ul style="list-style-type: none"> • Poor stream water quality due to pollutants, sedimentation 	<ul style="list-style-type: none"> • Reduce sedimentation from stream side activities, • Avoid chemicals and fertilizers

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
Athens Park	<ul style="list-style-type: none"> • Forest and Woodland Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • N/A
Bluestone Lake State Park	Forest and Woodland <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands Rock Outcrops, Cliffs and Talus, and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats 	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, Very High Gradient • Headwaters/Creeks, Cold, High Gradient • Medium Rivers, Transitional, Low Gradient • Medium Rivers, Transitional, High Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
Bluestone Lake Wildlife Management Area	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus • previous calcareous <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Developed • Agriculture <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • unknown wetland 	<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, Very High Gradient • Headwaters/Creeks, Cold, Very High Gradient • Headwaters/Creeks, Cold, Moderate Gradient • Headwaters/Creeks, Cold, Low Gradient • Headwaters/Creeks, Cold, High Gradient • Small Rivers, Transitional, High Gradient • Small Rivers, Transitional, Low Gradient • Small Rivers, Transitional, Moderate Gradient • Large/Great Rivers, Warm, Low Gradient • Small Rivers, Transitional, Very High Gradient • Large/Great Rivers, Warm, High Gradient • Large/Great Rivers, Warm, Moderate Gradient • Large/Great Rivers, Warm, Very High Gradient
Bluestone National Scenic River	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands • Anthropogenic Shrubland & Grassland <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p>	<ul style="list-style-type: none"> • Medium Rivers, Transitional, Low Gradient • Medium Rivers, Transitional, Moderate Gradient • Headwaters/Creeks, Transitional, Very High Gradient • Medium Rivers, Transitional, Very High Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
	<ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Developed • Agriculture <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats 	<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, Low Gradient • Medium Rivers, Transitional, High Gradient • Headwaters/Creeks, Transitional, High Gradient
Bluestone Recreation Area	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus • previous calcareous <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Developed • Agriculture <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • River Floodplains • Small Stream Riparian Habitats • unknown wetland • Open Water 	<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, Very High Gradient • Headwaters/Creeks, Cold, Very High Gradient • Medium Rivers, Transitional, Low Gradient • Medium Rivers, Transitional, Moderate Gradient • Medium Rivers, Transitional, Very High Gradient • Headwaters/Creeks, Transitional, Low Gradient • Medium Rivers, Transitional, High Gradient • Headwaters/Creeks, Cold, Moderate Gradient • Headwaters/Creeks, Cold, Low Gradient • Headwaters/Creeks, Cold, High Gradient • Small Rivers, Transitional, High Gradient • Small Rivers, Transitional, Low Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
		<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, High Gradient • Small Rivers, Transitional, Moderate Gradient • Large/Great Rivers, Warm, Low Gradient • Large/Great Rivers, Warm, High Gradient • Small Rivers, Transitional, Very High Gradient • Large/Great Rivers, Warm, Moderate Gradient • Large/Great Rivers, Warm, Very High Gradient
Bluestone State Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • unknown wetland 	<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, Very High Gradient • Headwaters/Creeks, Cold, Very High Gradient • Medium Rivers, Transitional, Low Gradient • Headwaters/Creeks, Transitional, High Gradient • Large/Great Rivers, Warm, High Gradient • Headwaters/Creeks, Transitional, Low Gradient • Large/Great Rivers, Warm, Low Gradient • Headwaters/Creeks, Cold, High Gradient • Medium Rivers, Transitional, High Gradient • Large/Great Rivers, Warm, Very High Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
Brush Creek Preserve	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains 	<ul style="list-style-type: none"> • Medium Rivers, Transitional, Very High Gradient • Small Rivers, Transitional, Very High Gradient
Camp Creek State Forest	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • Small Stream Riparian Habitats • unknown wetland 	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, High Gradient • Headwaters/Creeks, Cold, Very High Gradient • Headwaters/Creeks, Transitional, High Gradient • Headwaters/Creeks, Cold, Moderate Gradient
Camp Creek State Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests 	<ul style="list-style-type: none"> • Headwaters/Creeks, Transitional, High Gradient • Headwaters/Creeks, Cold, Very High Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
	<ul style="list-style-type: none"> • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Small Stream Riparian Habitats 	
Glenwood Recreational Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Pine-Oak Rocky Woodlands <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • Small Stream Riparian Habitats 	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, Low Gradient
Pinnacle Rock State Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Calcareous Forests, Woodlands, and Glades • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Calcareous Cliffs and Talus • previous calcareous <p>Agricultural and Developed</p>	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, Very High Gradient

Public Land	Terrestrial Habitat(s)	Aquatic Habitat(s)
	<ul style="list-style-type: none"> • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats 	
Pipestem Resort State Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry Oak (-Pine) Forests • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands <p>Rock Outcrops, Cliffs and Talus, and Shale Barrens</p> <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Agriculture • Developed <p>Aquatic, Floodplain, and Riparian</p> <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats 	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, Very High Gradient • Medium Rivers, Transitional, High Gradient • Headwaters/Creeks, Cold, High Gradient • Headwaters/Creeks, Transitional, Very High Gradient • Medium Rivers, Transitional, Very High Gradient
Princeton City Park	<p>Forest and Woodland</p> <ul style="list-style-type: none"> • Dry Oak (-Pine) Forests <p>Agricultural and Developed</p> <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • Headwaters/Creeks, Cold, High Gradient

Appendix 4. 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
<p>American Forest Foundation (AFF)</p> <p>https://www.forestfoundation.org/</p> <p>https://www.familyforestcarbon.org/</p>	<ul style="list-style-type: none"> • 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)
<p>Appalachian Mountains Joint Venture (AMJV)</p> <p>https://amjv.org/</p>	<ul style="list-style-type: none"> • 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.
<p>Cave Conservancy of the Virginias (CCV)</p> <p>https://caveconservancyofvirginia.org/</p>	<ul style="list-style-type: none"> • Promoting conservation, management, knowledge and acquisition of caves and karst resources in Virginia and West Virginia • Contributes to educational, research and environmental protection projects • Funds a variety of cave and karst education, outreach, research, cleanup and acquisition projects. • Provides research scholarships and stipends for graduate and undergraduate students • Supports <i>Project Underground</i> environmental education program to promote a better understand of caves and karst lands.

Partner	Role/Assistance Provided
<p>Consulting Foresters</p> <p>https://wvforestry.com/forestry-consultants/</p>	<ul style="list-style-type: none"> • 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
<p>County Farmland Protection Boards</p> <p>http://wvfp.org/</p>	<ul style="list-style-type: none"> • County Farmland Protection Boards and West Virginia Agricultural Land Protection Authority are authorized through WV Department of Agriculture, under the Voluntary Farmland Protection Act, to • Assist in sustaining the farming community • Provide sources of agricultural products within the state for citizens of the state • Control the urban expansion which is consuming the agricultural land, topsoil and woodland of the state • Curb the spread of urban blight and deterioration • Protect agricultural land and woodland as open-space land • Enhance tourism • Protect worthwhile community values, institutions & landscapes which are inseparably associated with traditional farming
<p>Forest Certification Programs:</p> <ul style="list-style-type: none"> • American Tree Farm System (ATFS) https://www.treefarmssystem.org/ • Sustainable Forestry Initiative (SFI) https://www.forests.org/ https://www.wvfa.org/sfi/ • Forest Stewardship Council (FSC) https://fsc.org/en 	<ul style="list-style-type: none"> • Resources, assistance and certification for sustainable forest management on public and private lands

Partner	Role/Assistance Provided
<p>Master Naturalists Program</p> <p>http://mnofwv.org/</p>	<ul style="list-style-type: none"> • 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
<p>National Speleological Society (NSS)</p> <p>https://caves.org/</p>	<ul style="list-style-type: none"> • Promotes safe and responsible caving practices, effective cave and karst management, speleology, and conservation. • Members work together in NSS grottos (i.e, chapters), regions, surveys, and sections to develop ideas and pursue projects in the areas of speleology, as well as cave conservation, management, preservation, restoration, exploration, surveying, rescue, equipment, techniques, and education.
<p>National Wild Turkey Federation (NWTf)</p> <p>https://www.nwtf.org/</p>	<ul style="list-style-type: none"> • 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
<p>Outdoor Heritage Conservation Fund (OHCF)</p> <p>https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/</p>	<ul style="list-style-type: none"> • 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
<p>Ruffed Grouse Society/American Woodcock Society (RGS)</p> <p>https://ruffedgrousesociety.org/#</p>	<ul style="list-style-type: none"> • 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 up capacity building, investment and conservation benefits from working forests to the landscape scale. <p>https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/</p>
<p>The Conservation Fund (TCF)</p> <p>https://www.conservationfund.org/where-we-work/west-virginia</p>	<ul style="list-style-type: none"> • 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.
<p>The Nature Conservancy (TNC)</p> <p>https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/</p>	<ul style="list-style-type: none"> • Assist public land managers with land protection, management and restoration to maintain landscape resilience and connectivity • Assist private landowners with land protection and improved management, including conservation easements and forest carbon projects • Manages a network of nature preserves and conservation easements for conservation and recreation
<p>Trout Unlimited (TU)</p> <ul style="list-style-type: none"> • http://www.wvtu.org/ • http://www.tu.org/ 	<ul style="list-style-type: none"> • 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

Partner	Role/Assistance Provided
<p>US Fish and Wildlife Service (USFWS)</p> <p>Partners for Fish and Wildlife Program</p> <p>https://www.fws.gov/northeast/ecologicalservices/partners.html</p>	<ul style="list-style-type: none"> • 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
<p>USDA Farm Service Agency (FSA)</p> <p>https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index</p> <ul style="list-style-type: none"> • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP) • State Acres for Wildlife Enhancement (SAFE) • Farmable Wetlands Program (FWP) • Grasslands Reserve Program (GRP) 	<ul style="list-style-type: none"> • CRP provides rental payments to agricultural producers participating voluntarily to safeguard environmentally sensitive land, conserve water quality, control soil erosion and enhance wildlife habitat, including floodplain wetlands. • CREP provides extra incentives and payments to eligible producers to reduce soil erosion and pollution, improve water quality and enhance terrestrial and aquatic wildlife habitat through practices such as riparian buffers and wetland restoration • The State Acres for Wildlife Enhancement (SAFE) Initiative provides farmers and landowners with assistance to establish wetlands, grasses and trees to enhance important wildlife populations by creating critical habitat and food sources, while protecting soil and water health. • The Farmable Wetlands Program (FWP) provides farmers and ranchers annual rental payments in return for restoration wetlands and wetland buffers zones. • The Grassland Reserve Program (GRP) provides farmers a rental payment to voluntarily prevent grazing and pasture land from being converted into cropland or urban development.

Partner	Role/Assistance Provided
<p>USDA Natural Resources Conservation Service (NRCS):</p> <p>https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/</p> <p>Environmental Quality Incentive Program (EQIP)</p> <ul style="list-style-type: none"> • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP) • Climate-Smart Agriculture and Forestry Mitigation Activities 	<ul style="list-style-type: none"> • 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.
<p>West Virginia Association for Cave Studies (WVACS)</p> <p>https://www.wvacs.org/</p>	<ul style="list-style-type: none"> • Contributes to cave surveys and research • Hosts cave scientists and graduate students pursuing cave research at field stations in Greenbrier County

Partner	Role/Assistance Provided
<p>West Virginia Cave Conservancy</p> <p>https://wvcc.net/</p>	<ul style="list-style-type: none"> • Manages caves to protect sensitive cave resources and environments • Educates and provides expertise to landowners, developers, local governments and the public on the value of cave and karst resources • Organizes cave and karst conservation projects including sinkhole cleanups and livestock barrier fences. • Preserves access to significant caves through ownership and management agreements • Sponsor research and survey projects on WVCC caves
<p>West Virginia Land Trust (WVLT)</p> <p>https://www.wvlandtrust.org/</p>	<ul style="list-style-type: none"> • 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.
<p>West Virginia Scenic Trails Association (WVSTA)</p> <p>https://www.wvscenictrails.org/</p>	<ul style="list-style-type: none"> • Serves the outdoor community by building and maintaining the Allegheny Trail and other trails in partnership and cooperation with landowners, managers, and others. • Maintains, preserves, protects, and promotes this challenging and scenic foot trail (that will exceed 300 miles) running southward from the Mason-Dixon Line through WV and VA to the Appalachian Trail. • Furthers the conservation of wild pristine lands and wildlife and protect areas of natural beauty and historic interest through stewardship
<p>West Virginia University Extension Service (WVU Extension):</p> <ul style="list-style-type: none"> • Forestry <p>https://extension.wvu.edu/natural-resources/forestry</p> <ul style="list-style-type: none"> • Wildlife <p>https://extension.wvu.edu/natural-resources/wildlife</p>	<ul style="list-style-type: none"> • 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
<p>WV Conservation Agency (WVCA) and Conservation Districts</p> <p>http://www.wvca.us</p> <ul style="list-style-type: none"> • Ag Enhancement Program (AgEP) • Non-Point Source Program • Stream Partners Program 	<ul style="list-style-type: none"> • 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.
<p>WV Department of Environmental Protection (WVDEP)</p> <ul style="list-style-type: none"> • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx • Rehabilitation Environmental Action Plan (REAP) https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx • WVDEP Youth Environmental Program (YEP) https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx 	<ul style="list-style-type: none"> • Supports partners and citizen-based watershed organizations in restoring impaired watersheds • Provides assistance in proper installation and maintenance of Best Management Practices • Provides funding for projects by watershed groups and partners to improve water quality in watersheds listed as impaired, including the Greenbrier River and many tributaries • Practices include wastewater treatment, agricultural BMPs, rain gardens for stormwater runoff, streambank restoration and community outreach • Save our Streams provides training for volunteers to monitor local wadable streams and rivers • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects

Partner	Role/Assistance Provided
<p>WV Department of Health and Human Resources (WVDHHR)</p> <ul style="list-style-type: none"> On-Site Sewage Program <p>https://www.wvdhhr.org/phs/sewage/index.asp</p>	<ul style="list-style-type: none"> 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.
<p>WV Division of Forestry (WVDOF)</p> <p>http://www.wvforestry.com/</p>	<ul style="list-style-type: none"> 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
<p>WV Division of Natural Resources (WVDNR)</p> <p>https://wvdnr.gov/</p>	<ul style="list-style-type: none"> Identification of SGCN and rare communities Education, outreach and teaching resources Field guides, Landscaping and Management guidelines Fish and game management Habitat restoration assistance Natural Areas Program

Appendix 5. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05050002003405	WVKN-59_01	AdairRun	Fecal
05050002001340	WVKN-59_02	AdairRun	Fecal
05050002001553	WVKNB-22-C_00	BarnBranch	Fecal
05050002001506	WVKNB-30-C_00	BelcherBranch	Iron, Selenium
05050002000571	WVKNB-22_00	BlacklickCreek	Fecal
05050002001986	WVKNB_01	BluestoneRiver	Fecal, PCBs
05050002000064	WVKNB_02	BluestoneRiver	Bio, Fecal, PCBs
05050002001625	WVKN-51-A_00	BradshawCreek	Fecal
05050002000389	WVKN-61-A_00	BrushCreek	Fecal
05050002000108	WVKNB-12_01	BrushCreek	Fecal, Iron
05050002000109	WVKNB-12_02	BrushCreek	Bio, Fecal, Iron
05050002004042	WVKNB-35_00	ButtHollow(LickBranch)	Fecal
05050002001661	WVKNB-13_00	CampCreek	Fecal
05050002000741	WVKN-51-I_00	CooksRun	Fecal
05050002001674	WVKNB-30_00	CraneCreek	Bio, Fecal, Iron_Trout
05050002000814	WVKN-61-C_00	CrookedCreek	Fecal
05050002000383	WVKN-61-E_02	DryCreek	Fecal, Iron
05050002000381	WVKN-61-E_01	DryCreek	Bio, Fecal, Iron
05050002000771	WVKN-51-R_00	GinHollow	Fecal
05050002001561	WVKNB-12-H_00	GladyFork	Fecal
05050002003467	WVKNB-28-A_00	GodfreyBranch	Bio
05050002000395	WVKN-51-D_00	HansCreek	Fecal
05050002000769	WVKN-51_02	IndianCreek	Bio, Fecal
05050002000659	WVKN-51_01	IndianCreek	Fecal
05050002001628	WVKN-51-G_00	IndianDraft	Fecal
05050002001636	WVKN-51-H-(S)_00	LaurelCreek	Fecal
05050002000124	WVKNB-12-B_00	LaurelCreek	Fecal
05050002000080	WVKNB-34.5_00	LaurelFork	Bio, Fecal
05050002001690	WVKNB-28-C_00	LefthandFork/WidemouthCreek	Fecal
05050002001569	WVKNB-12-J-2_00	MiddleFork/SouthFork/BrushCreek	Fecal
05050002000015	WVKNB-5_01	MountainCreek	Fecal
05050002002697	WVKN-61-D_00	MudRun	Fecal
05050002000625	WVKNB-5-B_00	NorthFork/MountainCreek	Fecal
05050002000820	WVKN-61-E-1_00	PainterRun	Fecal
05050002001392	WVKNB-1_02	PipestemCreek	Fecal
05050002001942	WVKNB-1_01	PipestemCreek	Fecal
05050002001393	WVKNB-1_03	PipestemCreek	Fecal
05050002000378	WVKN-61-(S)_00	RichCreek	Fecal
05050002001665	WVKNB-18_02	RichCreek	Fecal, Iron
05050002000049	WVKNB-18_01	RichCreek	Fecal
05050002000069	WVKNB-28-B_00	RighthandFork/WidemouthCreek	Bio, Fecal, Iron
05050002001709	WVKN-51-K_00	RockCampCreek	Fecal
05050002001555	WVKNB-22-A_00	RockyBranch	Fecal
05050002000807	WVKN-61-B_00	ScottBranch	Fecal
05050002001514	WVKNB-33_00	SimmonsCreek	Bio, Fecal, Iron

Reach Code	AUID	Common Name	Impairments
05050002000627	WVKNB-12-J_00	SouthFork/BrushCreek	Fecal
05050002000633	WVKN-51-B_00	StinkingLickCreek	Fecal
05050002001728	WVKNB-3-A_00	SuckCreek	Fecal
05050002000661	WVKN-51-O_00	TurkeyCreek	Fecal
05050002001731	WVKNB-30-D.5_00	UNT/CraneCreekRM4.47	Fecal, pH
05050002000776	WVKN-51-G-1_00	UNT/IndianDraftRM1.46	Fecal
05050002001418	WVKNB-3-C-1-D_00	UNT/JumpingBranchRM1.99	Fecal
05050002001419	WVKNB-3-C-1-E_00	UNT/JumpingBranchRM2.48	Bio, Fecal
05050002001775	WVKNB-12-K-(L2)_00	UpperGlenwoodParkLake	Phosphorus
05050002000068	WVKNB-28_02	WidemouthCreek	Fecal
05050002000065	WVKNB-28_01	WidemouthCreek	Fecal, Iron_Trout
05050002000667	WVKNB-15_00	WolfCreek	Fecal

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 Southern and Greenbrier Valley Conservation Districts

Summarizes natural resources conditions and ranks resource concerns that could be addressed through NRCS technical and financial assistance. Available at:

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/eqip/?cid=nrcseprd1167606>

New River Watershed- Watershed Based Plans for Indian Creek and Pipestem Creek. Available at:

<https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx>

Living on Karst- A Reference Guide for Landowners in Limestone Regions

http://www.livingonkarst.org/living_on_karst.htm

Guidelines for Cave and Karst Protection- IUCN

<https://www.iucn.org/content/guidelines-cave-and-karst-protection-0>

A Guide to Responsible Caving, by the National Speleological Society

https://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf

National Wild Turkey Foundation- Landowner's Toolbox

https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf-tool-box

Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests

http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf

Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners.

https://www.allaboutbirds.org/bbimages/clo/pdf/GWWA-APPLRegionalGuide_130808_lo-res.pdf

Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors: <https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf>

West Virginia Pollinator Handbook – A Field Office Technical Guide Reference to management of pollinators and their habitats. Developed by WV NRCS Ecological Sciences in conjunction with WV Division of Natural Resources and the Xerces Society for Invertebrate Conservation.

<http://xerces.org/sites/default/files/publications/12-049.pdf>

Brochures about Aquatic Invasive Species, Forest Pests and Pathogens, and Invasive Plant Species

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/>

West Virginia Invasive Species Strategic Plan and Voluntary Guidelines, 2014

https://eos.ucs.uri.edu/seagrant_Linked_Documents/mdu/2014-09_RO_Anderson_M_INV-3b.pdf

Fighting Invasive Plants in West Virginia

<http://www.wvnps.org/FightingInvasives.pdf>

American Forest Foundation: Woodland owners planning tool for forest management

<https://mylandplan.org/>

The Nature Conservancy Resilient Land Mapping Tool and Documents:

<http://maps.tnc.org/resilientland/>

USDA Forest Service, Northern Research Station's Climate Change Atlas: documentation of current and possible future distribution of 134 tree species and 147 bird species in the Eastern United States

<https://www.fs.fed.us/nrs/atlas/>

Rudnick, D.A. et al. 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America.

<https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities>

Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science:

<https://adaptationworkbook.org/>

U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information and subject matter expertise to build climate resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location.

<https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice>

Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition, 2016, published by the USDA Forest Service, Northern Research Station

<https://www.nrs.fs.fed.us/pubs/52760>

Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture.

<https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf>