

Action Plan for the Little Kanawha River & Middle Island Creek Conservation Focus Area



November, 2023

Table of Contents

Executive Summary	1
Introduction to the State Wildlife Action Plan & Conservation Focus Areas.....	2
Species of Greatest Conservation Need, Habitats and Stresses	2
Conservation Actions	2
Conservation Focus Areas and Action Plans	3
Climate Change and Resilience	4
Monitoring and Adaptive Management	5
Organization of this Action Plan.....	6
How to use this plan.....	7
Little Kanawha River & Middle Island Creek Conservation Focus Area	8
Overview	8
Habitats	10
Terrestrial Habitats.....	10
Aquatic Habitats.....	12
Species of Greatest Conservation Need.....	14
Distinctive Stresses.....	15
Conservation Actions	15
Potential Partners	15
Protected Lands	16
Action Plan for the Conservation Focus Area	18
Conservation Goals	18
Priority Species.....	18
Forest and Woodland Habitats	22
Priority Species.....	22
Rare Plant Communities.....	23
Habitat Stresses and Conservation Actions	27
Climate Change and Habitat Resilience	28
Implementation Plan.....	30
Human Benefits.....	34
Aquatic, Floodplain and Riparian Habitats.....	35
Priority Species.....	35
Rare Plant Communities.....	37

Habitat Stresses and Conservation Actions	41
Climate Change and Habitat Resilience	42
Implementation Plan.....	44
Human Benefits.....	47
Agricultural and Developed Habitats	48
Priority Species.....	48
Habitat Stresses and Conservation Actions	50
Climate Change and Habitat Resilience	50
Implementation Plan.....	52
Human Benefits.....	54
Landscape Resilience and Connectivity	55
Climate Stresses and Conservation Actions	60
Implementation Plan.....	60
Conclusion	62
Habitat Conservation Priorities.....	62
Integration of Conservation Actions	62
Connecting Conservation Actions for Climate Resilience	63
Next Steps in Implementation	63
References.....	64
Appendix 1. SGCN in the Middle Island Creek and Little Kanawha CFA	66
Appendix 2. Priority SGCN, Known Stresses and Actions.....	74
Appendix 3. Habitats on Public Lands	82
Appendix 4. Impaired Streams.....	88
Appendix 5. Partners and Assistance Provided.....	94
Appendix 6. Resources	102

List of Tables

Table 1. Terrestrial Habitat Summary	10
Table 2. Aquatic Habitat Summary.....	12
Table 3. Species Summary by Taxa	14
Table 4. Priority Species in the CFA.....	19
Table 5. Priority Species in Forest and Woodland Habitats.....	22
Table 6. Rare Plant Communities in Forest and Woodland Habitats.....	23
Table 7. Habitat Stresses and Conservation Actions in Forest and Woodland Habitats	27
Table 8. Climate Stresses and Resilience Actions in Forest and Woodland Habitats	30
Table 9. Implementation Plan for Forest and Woodland Habitats	31
Table 14. Priority Species in Aquatic Habitats	35
Table 15. Priority Species in Riparian and Floodplain Habitats.....	36
Table 16. Rare Plant Communities in Aquatic, Floodplain and Riparian Habitats.....	37
Table 17. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat.....	41
Table 18. Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat	44
Table 19. Implementation Plan for Aquatic, Floodplain and Riparian Habitats	44
Table 20. Priority Species in Agricultural and Developed Habitats.....	48
Table 21. Habitat Stresses and Conservation Actions in Agricultural & Developed Habitats.....	50
Table 22. Climate Stresses and Resilience Actions for Agricultural and Developed Habitats	51
Table 23. Implementation Plan for Agricultural and Developed Habitats.....	52
Table 24. Climate Stresses and Actions for Landscape Resilience and Connectivity	60
Table 25. Implementation Plan for Landscape Resilience and Connectivity	61

List of Maps

Map 1. Conservation Focus Areas in West Virginia.....	4
Map 2. Overview	9
Map 3. Terrestrial Habitats	11
Map 4. Aquatic Habitats.....	13
Map 5. Protected Lands and Biodiversity	17
Map 6. Forest and Woodland Habitats	24
Map 7. Intact Forest Patches and Biodiversity	25
Map 8. Rock Outcrop, Cliff & Talus Habitats.....	26
Map 9. Riparian and Floodplain Habitats.....	38
Map 10. Mussel Streams, Wetlands and Biodiversity.....	39
Map 11. Impaired Streams and Biodiversity	40
Map 12. Developed & Agricultural Lands, and Biodiversity.....	49
Map 13. Landscape Integrity.....	56
Map 14. Resilient and Connected Network – Regional View.....	58
Map 15. Resilient and Connected Network – Detailed View	59

List of Acronyms Used

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

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species, and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups and other non-profit conservation organizations working in the area to develop this Action Plan for the Little Kanawha River and Middle Island Creek CFA. This Action Plan addresses the eight essential elements required in the SWAP. It provides an overview of the landscape and major habitat types within this CFA, including forest and woodland habitats, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. It also identifies 216 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the Action Plan lists the priority species, stresses, and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. A plan for implementation for each major habitat type lists partners and programs available to assist with each of the actions and metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The Action Plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA, and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience, and outlines next steps in plan implementation.

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

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

Introduction to the State Wildlife Action Plan & Conservation Focus Areas

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

Species of Greatest Conservation Need, Habitats and Stresses

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

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

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

Conservation Actions

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

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

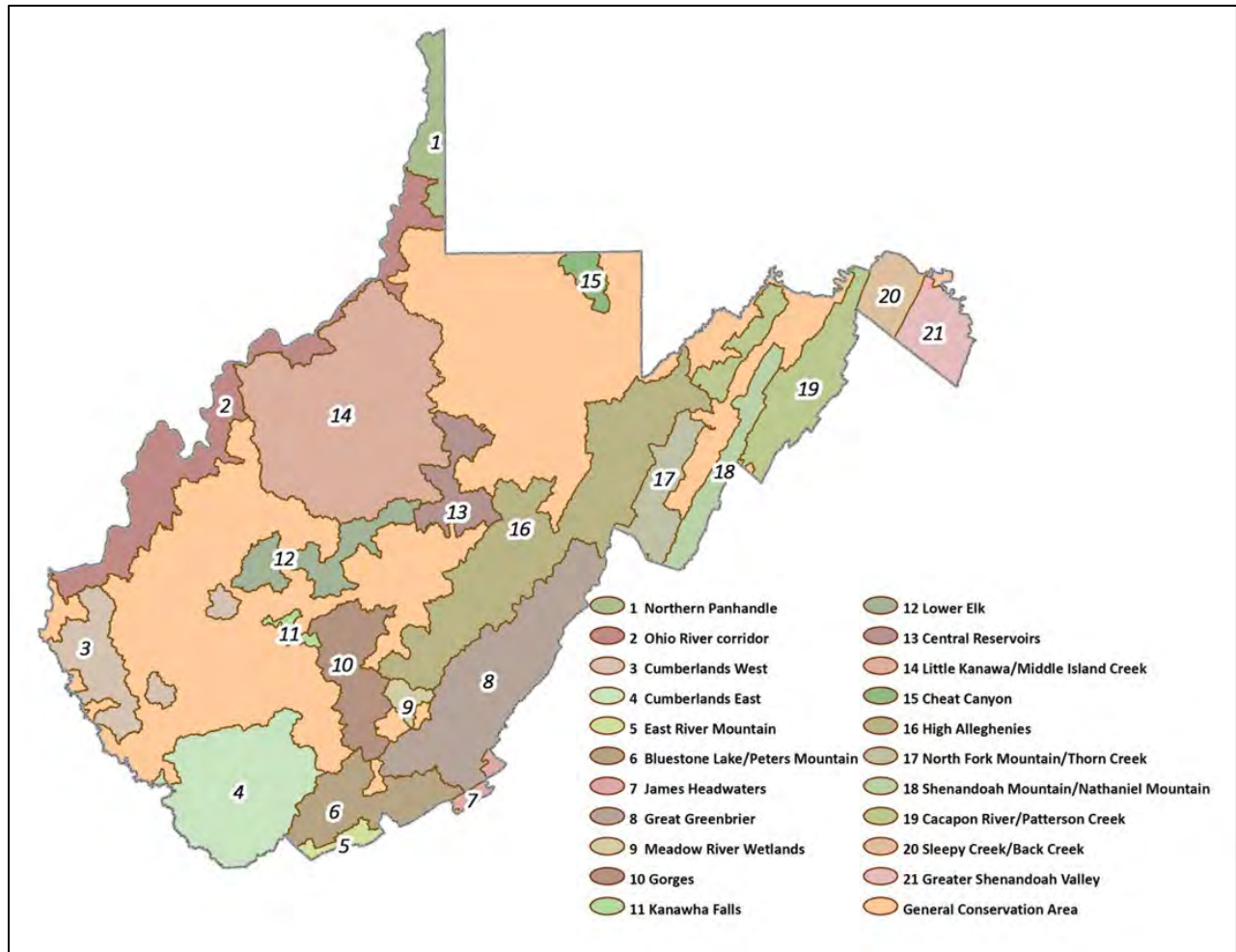
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve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

Conservation Focus Areas and Action Plans

The SWAP provides a broad framework for conservation across West Virginia. However, wildlife species are concentrated in different parts of the state and exposed to multiple stresses at state, regional and 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

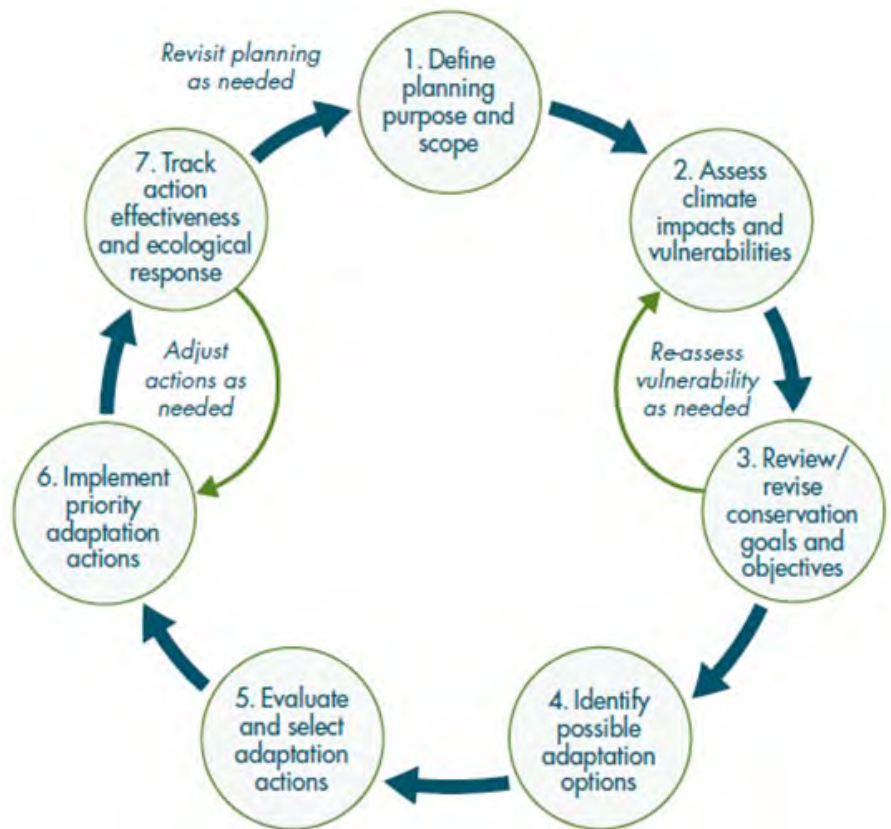
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach, 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 for greater impact, connecting conservation actions for climate resilience and outlines next steps in plan implementation.

How to use this plan

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

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

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

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

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

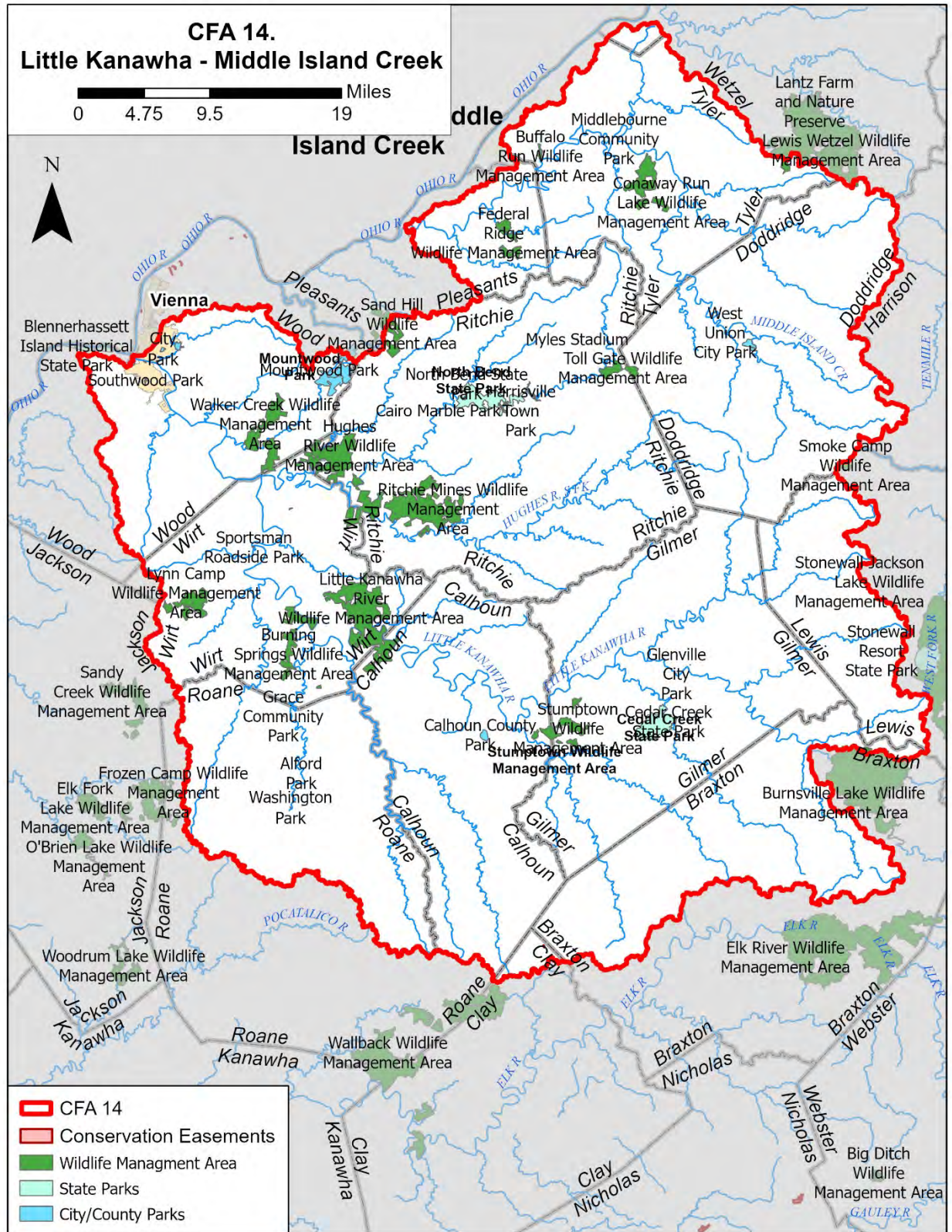
Little Kanawha River & Middle Island Creek Conservation Focus Area

Overview

The Little Kanawha River and Middle Island Creek are two significant tributaries of the Ohio River. These watersheds, in the Western Allegheny Plateau Ecoregion, are characterized by a primarily forested, dissected topography of rolling, lower elevation shale and sandstone hills bisected by numerous streams. Ridges remain largely covered by second and third growth mixed oak and Mixed Mesophytic Forests. Forested areas are primarily small to medium, non-industrial, private holdings with some industrial timber land. Small farms occur on ridges and in stream bottoms.

Several small cities including West Union, Harrisville, Elizabeth, Grantsville and Glenville, and numerous small towns occur in the narrow valleys. Wider valley bottoms are often used by small farms, primarily for hayfields or pastures. Gas and oil development were historically widespread, with deep mining for coal in the eastern portions of the CFA. Horizontal gas drilling has been increasing in recent years and related wells, roads, pipelines, compressor stations and staging areas have become significant features fragmenting the landscape.

Map 2. Overview



Habitats

The Little Kanawha River and Middle Island Creek CFA includes a variety of terrestrial, aquatic, and subterranean habitat types.

Terrestrial Habitats

Eleven of the habitat types described in the SWAP are present in this CFA. Forest habitats comprise the majority of terrestrial habitat types within the CFA, covering over 80% of total area. Less abundant habitat types are scattered across the CFA and are composed of habitats associated with rocky or riparian areas and developed and agricultural land. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat	Acres in CFA	% of CFA Area	% of WV Total for Type
Acidic Rock Outcrops, Cliffs, and Talus	210	0.01%	0.23%
Agriculture	128,132	7.40%	8.93%
Anthropogenic Shrubland & Grassland	8,199	0.47%	5.15%
Calcareous Cliffs and Talus	647	0.04%	7.03%
Developed	99,534	5.75%	8.74%
Dry Oak (-Pine) Forests	350,836	20.27%	14.20%
Dry-Mesic Oak Forests	583,210	33.69%	11.69%
Mixed Mesophytic Forests	491,375	28.39%	16.68%
Northern Hardwood Forests	203	0.01%	0.02%
River Floodplains	13,167	0.76%	10.95%
Small Stream Riparian Habitats	49,914	2.88%	10.10%
Unresolved	5,510	0.32%	4.72%
Totals	1,730,938	100.00%	

Map 3. Terrestrial Habitats



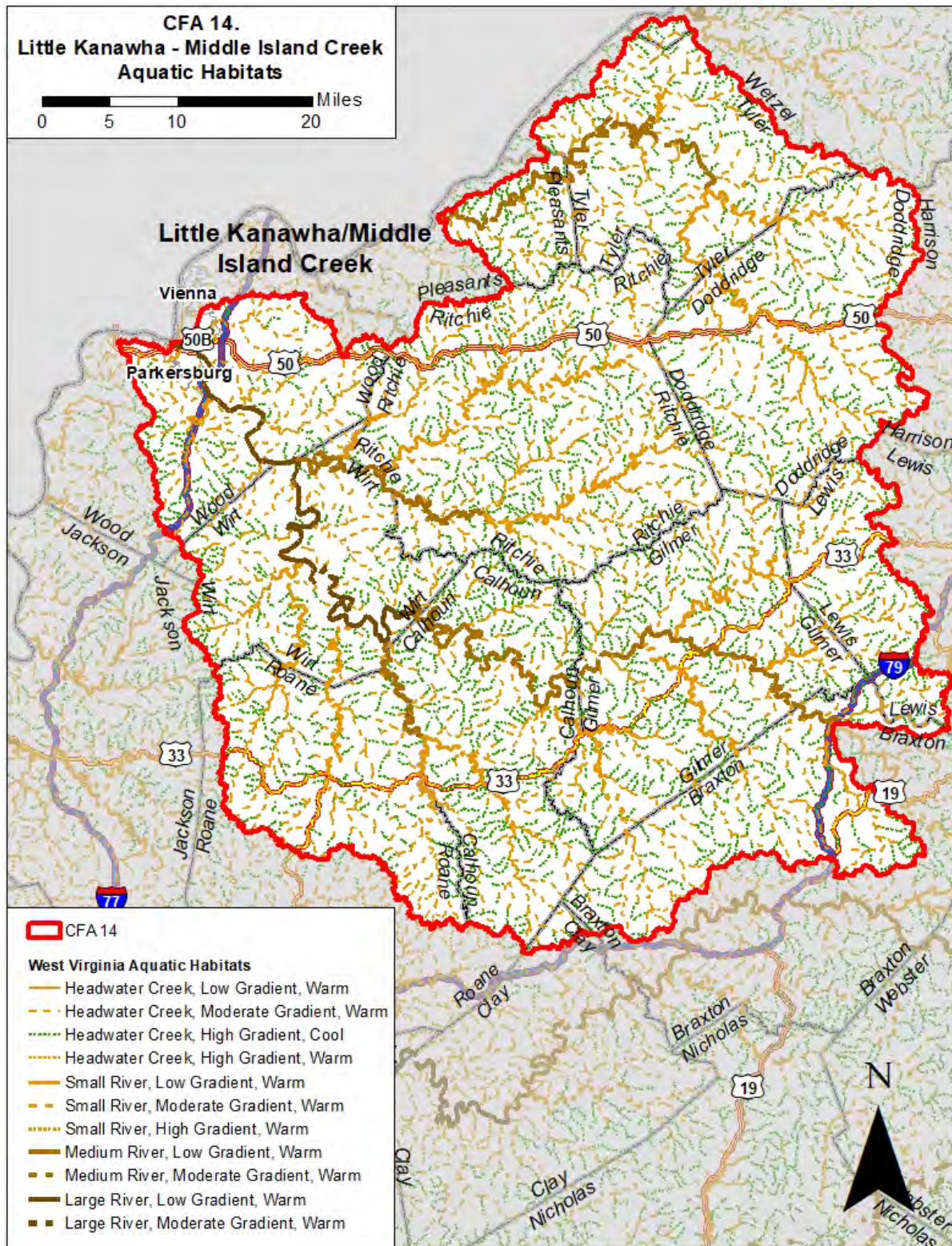
Aquatic Habitats

Eleven of the aquatic habitat types described in the SWAP are present within the Little Kanawha/Middle Island Creek CFA, including more than 40% of the state's warm, moderate gradient headwater creek habitat. Aquatic habitats are described in Chapter 3 of the 2015 SWAP.

Table 2. Aquatic Habitat Summary

Habitat Type	Miles in CFA	% of CFA Area	% of WV Total for Type
Headwater Creek, Low Gradient, Warm	211	5.30%	37.95%
Headwater Creek, Moderate Gradient, Warm	1,697	42.58%	43.45%
Headwater Creek, High Gradient, Cool	1,557	39.06%	24.85%
Headwater Creek, High Gradient, Warm	13	0.33%	1.71%
Small River, Low Gradient, Warm	206	5.18%	44.92%
Small River, Moderate Gradient, Warm	83	2.09%	15.35%
Small River, High Gradient, Warm	0	0.00%	1.18%
Medium River, Low Gradient, Warm	147	3.70%	30.99%
Medium River, Moderate Gradient, Warm	15	0.38%	4.34%
Large River, Low Gradient, Warm	51	1.29%	8.85%
Large River, Moderate Gradient, Warm	4	0.09%	3.32%
Totals	3,985	100.00%	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

Table 3 lists the number of Priority 1 and 2 SGCN in each taxa listed by WVDNR for the Little Kanawha River and Middle Island Creek CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	9
Birds	26
Butterflies and Moths	5
Dragonflies and Damselflies	25
Fish	24
Mammals	9
Mussels	38
Plants	40
Reptiles	16
Snails	23
Tiger Beetles	1
Total	216

Both Middle Island Creek and Little Kanawha River watersheds include significant portions of the State's warm and coolwater habitats, which support a significant portion of the mussel and fish diversity in West Virginia. They are home to 111 known fishes (24 SGCN) and 38 SGCN mussels, including the federally endangered Snuffbox and Clubshell mussels. The streams are the state's best locations for the Snuffbox, and in 2013 Clubshell populations were augmented as part of a large-scale restoration effort. A 35-mile reach of the Little Kanawha River from Yellow Creek downstream to Reedy Creek, easily accessed in several places by WV Route 5, is particularly diverse with habitats for an abundance of mussels and fishes. Streams in this CFA are also home to the Eastern Hellbender. Streams and wetlands in the CFA are among the state's most important habitats for dragonflies and damselflies (25 SGCN).

The extensive forests make this area important for conservation of widespread forest types including oak hickory, mesic cove, and maple beech forests. The CFA also contain several of the most extensive, relatively unfragmented forest blocks remaining in the Western Allegheny Plateau Ecoregion. These watersheds provide significant breeding habitat for interior forest birds, including a large percentage of the Cerulean Warblers that breed in West Virginia.

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

Distinctive Stresses

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

- This is an area of intensive and expanding shale gas development and associated infrastructure that fragments or eliminates habitat and adds sediment loads to the streams.
- Spills containing brine fluids and hazardous materials and/or water withdrawals put aquatic species at risk.
- The minimum flow below North Bend Dam is only 1 cubic foot per second (cfs), which prolongs drought conditions and may harm aquatic life.
- Because of the geology in this portion of the state, any ground-disturbing activities can result in significant siltation of the streams.

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

Conservation Actions

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

- Engage with the gas industry to develop infrastructure plans that reduce fragmentation and other habitat impacts.
- Partner with state parks and other public land agencies to develop management plans that maintain intact forest habitat.
- Partner with the WVDEP and WVDNR Fisheries to identify the causes of low flow and low dissolved oxygen and develop corrective strategies.
- Partner with WVDEP, gas extraction companies, and local governments to develop and implement ecologically sustainable water use protocol for streams.

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

Potential Partners

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

- West Virginia Department of Environmental Protection (WVDEP)
- U.S Fish and Wildlife Service (USFWS)
- Natural Resource Conservation Service (NRCS)
- Watershed groups
- Appalachian Mountain Joint Venture (AMJV)
- Gas industry county planning commissions

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

implementation and monitoring. In many cases, partners may assume a lead role in implementing 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

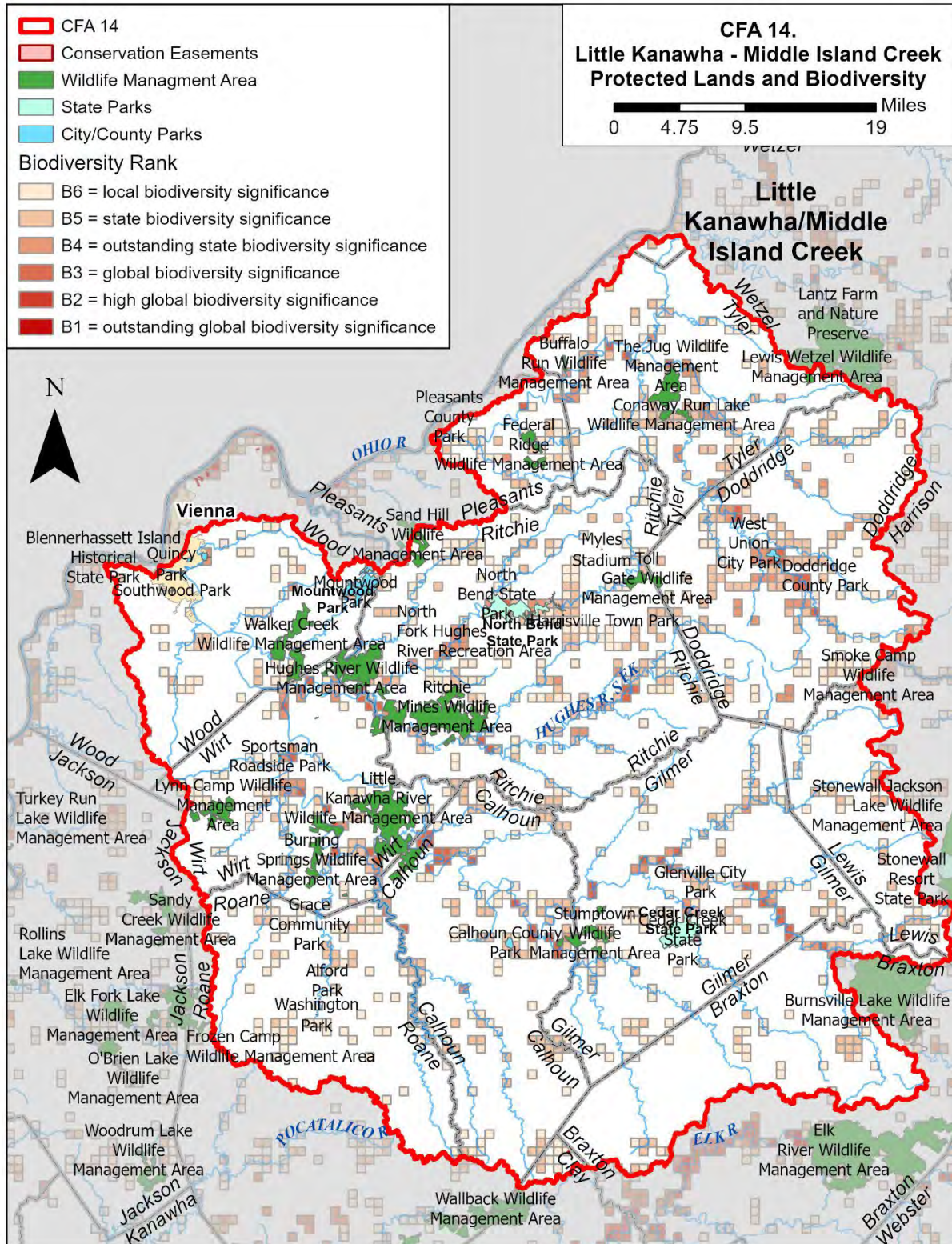
Public lands that may provide significant opportunities for wildlife conservation include:

- North Bend State Park
- North Bend Rails Trail State Park
- Cedar Creek State Park
- The Jug WMA
- Ritchie Mines WMA
- Sand Hill WMA
- Stumptown WMA
- Buffalo Run WMA
- Mountwood Community Park and other local parks

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. In addition, land trusts including Wetlands Reserve Program and The Nature Conservancy hold conservation easements that may protect important wildlife habitat and provide additional wildlife conservation opportunities.

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

Map 5. Protected Lands and Biodiversity



Action Plan for the Conservation Focus Area

Conservation Goals

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

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

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

Priority Species

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

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

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

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

Table 4. Priority Species in the CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank
Amphibians	<i>Cryptobranchus alleganiensis</i>	Eastern Hellbender	S2	G3G4
Amphibians	<i>Necturus maculosus</i>	Mudpuppy	S4	G5
Birds	<i>Antrastomus vociferus</i>	Eastern Whip-poor-will	S3B	G5
Birds	<i>Ardea herodias</i>	Great Blue Heron	S3B,S4N	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>Geothlypis formosa</i>	Kentucky Warbler	S3B	G5
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler	S3B	G5
Birds	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5
Birds	<i>Icteria virens</i>	Yellow-breasted Chat	S3B	G5
Birds	<i>Megaceryle alcyon</i>	Belted Kingfisher	S3B	G5
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush	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
Birds	<i>Setophaga discolor</i>	Prairie Warbler	S3B	G5
Birds	<i>Spizella pusilla</i>	Field Sparrow	S3B, S3N	G5
Birds	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5
Butterflies & Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr	S3	G4G5
Dragonflies & Damselflies	<i>Celithemis fasciata</i>	Banded Pennant	S3	G5
Dragonflies & Damselflies	<i>Enallagma vesperum</i>	Vesper Bluet	S3	G5

Taxa	Scientific Name	Common Name	S Rank	G Rank
Dragonflies & Damselflies	<i>Gomphurus fraternus</i>	Midland Clubtail	S2	G5
Dragonflies & Damselflies	<i>Phanogomphus quadricolor</i>	Rapids Clubtail	S3	G3G4
Dragonflies & Damselflies	<i>Sympetrum ambiguum</i>	Blue-faced Meadowhawk	S1	G5
Fish	<i>Ammocrypta pellucida</i>	Eastern Sand Darter	S3	G3
Fish	<i>Chrosomus erythrogaster</i>	Southern Redbelly Dace	S2S3	G5
Fish	<i>Etheostoma tippecanoe</i>	Tippecanoe Darter	S2	G3G4
Fish	<i>Ichthyomyzon bdellium</i>	Ohio Lamprey	S2S3	G3G4
Fish	<i>Ichthyomyzon greeleyi</i>	Mountain Brook Lamprey	S1	G3G4
Fish	<i>Ictiobus cyprinellus</i>	Bigmouth Buffalo	S1	G5
Fish	<i>Ictiobus niger</i>	Black Buffalo	S2	G5
Fish	<i>Lethenteron appendix</i>	American Brook Lamprey	S2	G4
Fish	<i>Notropis boops</i>	Bigeye Shiner	S1	G5
Fish	<i>Percina phoxocephala</i>	Slenderhead Darter	S1	G5
Fish	<i>Polyodon spathula</i>	Paddlefish	S1	G4
Mammals	<i>Myotis septentrionalis</i>	Northern Myotis	S3	G2G3
Mussels	<i>Epioblasma triquetra</i>	Snuffbox	S2	G3
Mussels	<i>Fusconaia subrotunda</i>	Long-solid	S3	G3
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut	S3	G4
Mussels	<i>Pleurobema clava</i>	Clubshell	S1	G2
Mussels	<i>Simpsonaias ambigua</i>	Salamander Mussel	S2	G3
Plants	<i>Dasistoma macrophylla</i>	Mullein Foxglove	S2	G4
Plants	<i>Enemion biternatum</i>	Eastern False Rue-anemone	S1	G5
Plants	<i>Potamogeton tennesseensis</i>	Tennessee Pondweed	S2	G2
Plants	<i>Pycnanthemum clinopodioides</i>	Basil Mountain-mint	SH	G2

Taxa	Scientific Name	Common Name	S Rank	G Rank
Plants	<i>Trillium flexipes</i>	Nodding Wakerobin	S2	G5
Reptiles	<i>Apalone spinifera spinifera</i>	Eastern Spiny Softshell	S4	G5T5
Reptiles	<i>Crotalus horridus</i>	Timber Rattlesnake	S3	G4
Reptiles	<i>Graptemys ouachitensis</i>	Ouachita Map Turtle	S1	G5
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

Forest Habitat within the CFA is primarily Dry-Mesic Oak, Mixed Mesophytic and Dry Oak (Pine) Forests. Many of the dry forest types are threatened by invasive species, mesophication (gradual moistening), and lack of fire, while overbrowsing by deer reduces regeneration of oak and other palatable understory species.

Maps 6 & 7 on the following maps display forest habitat types and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity within the CFA. The diversity of forest types across a variety of aspects and topography 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 portion of the 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.

In addition, acidic rock outcrops, cliffs, and talus and calcareous cliffs and talus habitats are scattered throughout the forested landscapes of this CFA, with heavier concentrations in the southern region. These habitats are typically found along streams and rivers running through the CFA such as the Little Kanawha River and are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Map 8 illustrates the location of these rare habitat types, and those in smaller forest patches may be more vulnerable to stresses. Timber Rattlesnake and Basil Mountain-mint are priority species associated with forests and woodlands as well as cliffs and talus habitats, and are included on the table below.

Priority Species

Table 5 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
Birds	<i>Antrostomus vociferus</i>	Eastern Whip-poor-will
Birds	<i>Buteo platypterus</i>	Broad-winged Hawk
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler
Birds	<i>Helmitheros vermivorum</i>	Worm-eating Warbler
Birds	<i>Hylocichla mustelina</i>	Wood Thrush
Birds	<i>Icteria virens</i>	Yellow-breasted Chat
Birds	<i>Piranga rubra</i>	Summer Tanager
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler
Birds	<i>Setophaga discolor</i>	Prairie Warbler

Birds	Vermivora cyanoptera	Blue-winged Warbler
Butterflies and Moths	Cyllopsis gemma	Gemmed Satyr
Mammals	Myotis septentrionalis	Northern Myotis
Plants	Dasistoma macrophylla	Mullein Foxglove
Plants	Enemion biternatum	Eastern False Rue-anemone
Plants	Pycnanthemum clinopodioides	Basil Mountain-mint
Plants	Trillium flexipes	Nodding Wakerobin
Reptiles	Crotalus horridus	Timber Rattlesnake
Reptiles	Terrapene carolina carolina	Eastern Box Turtle

Large, intact forest blocks support many forest interior breeding birds, including Broad-winged Hawk, Wood Thrush, Cerulean Warbler, and Worm-eating Warbler while early successional forest habitats support Prairie Warbler. Several rare plant species are associated with Pine-Oak Rocky Woodlands and Dry Oak-Pine Forests, but additional surveying will be required to ascertain their status and location.

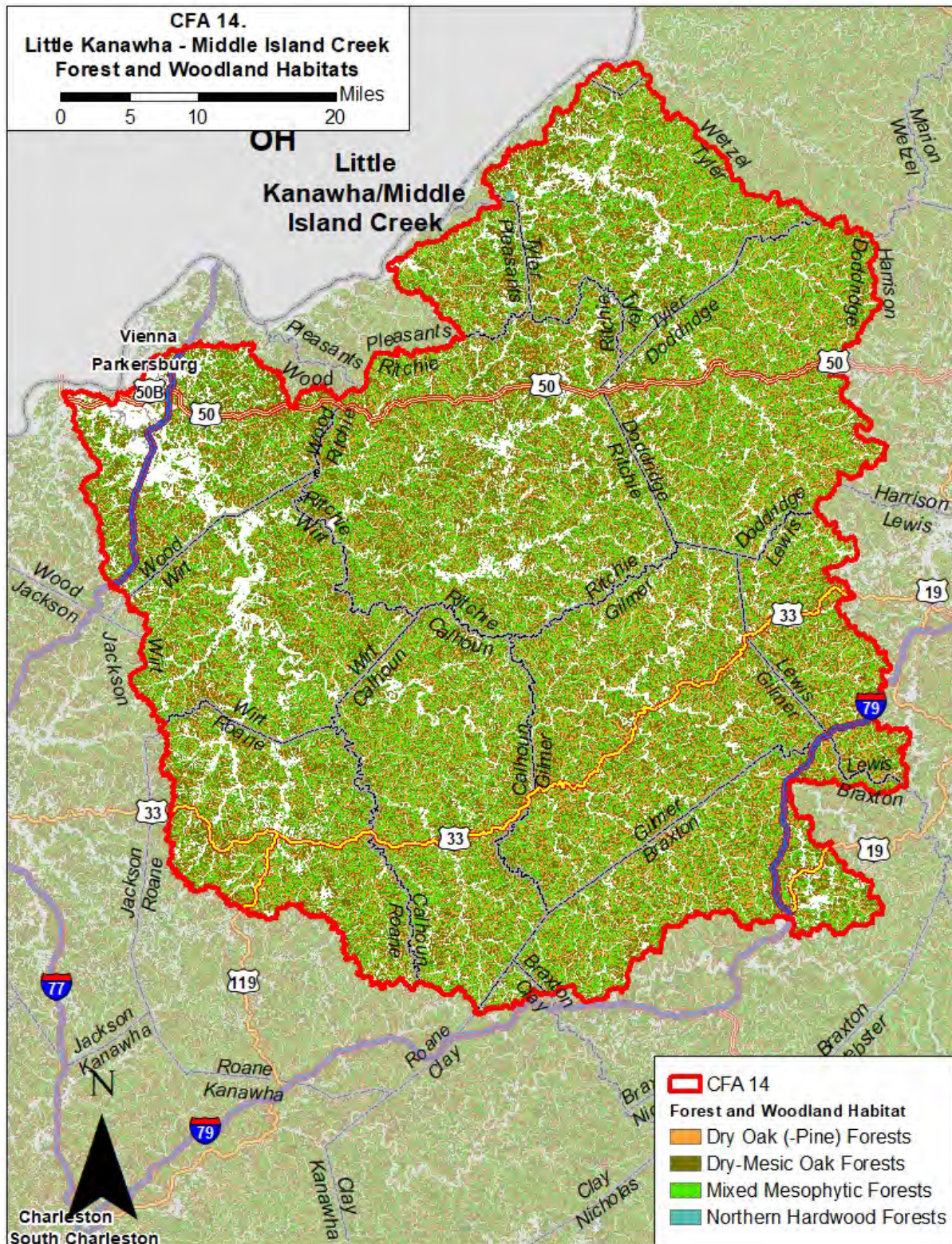
Rare Plant Communities

The following rare plant communities are found in Forest and Woodland habitats in this CFA. Note that a third of the state's Short Leaf Pine – Oak is located here. These communities are vulnerable to disturbance by logging and grazing activities, and to the spread of nonnative invasive plants. Disturbance should be avoided, and nonnative invasive plant infestations should be treated.

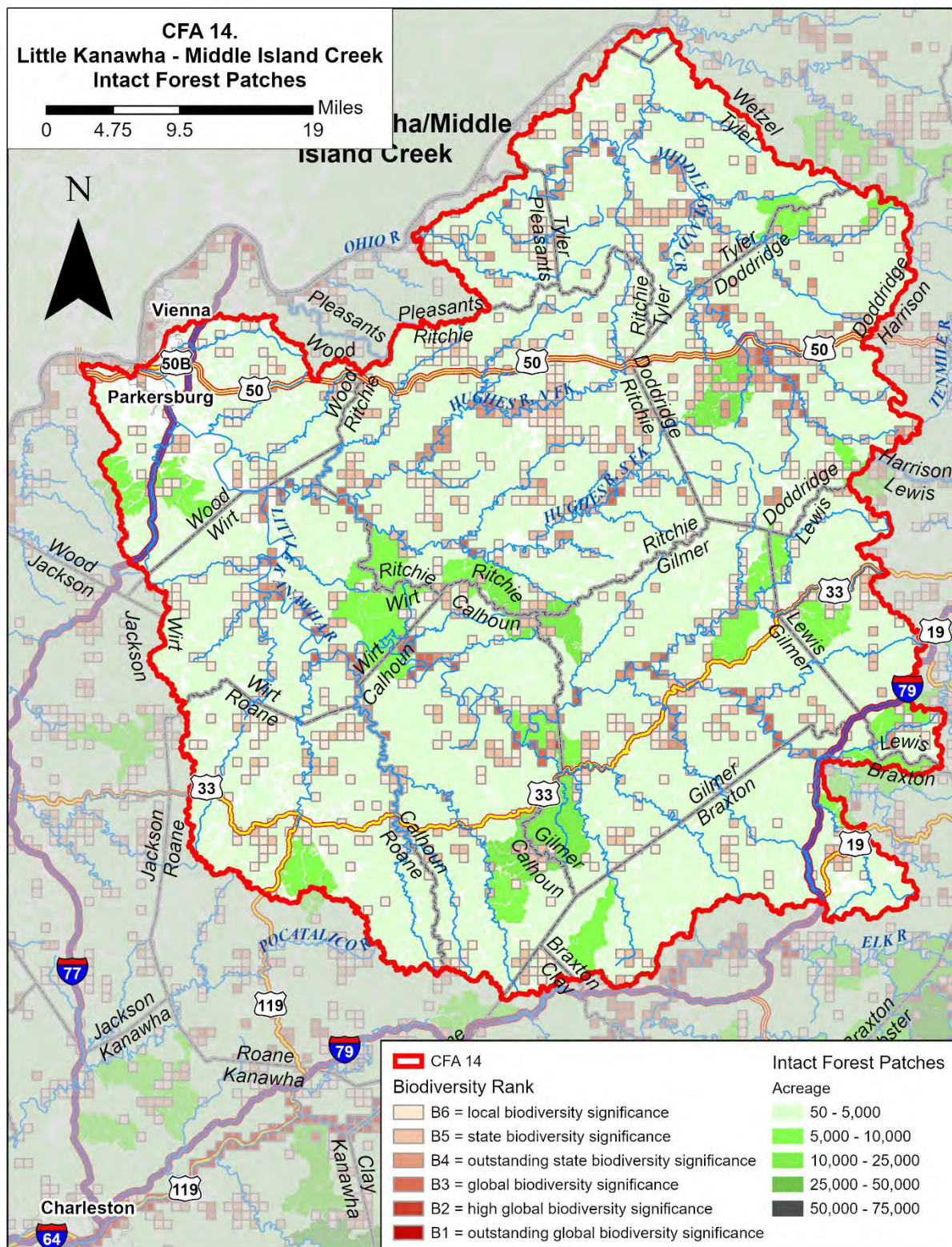
Table 6. Rare Plant Communities in Forest and Woodland Habitats.

Common Name	Relative Abundance	G Rank	S Rank
Short Leaf Pine - Oak Forest	33%	G2	S2
Low Elevation Calcareous Cove Forest	22%	G4G5	S2

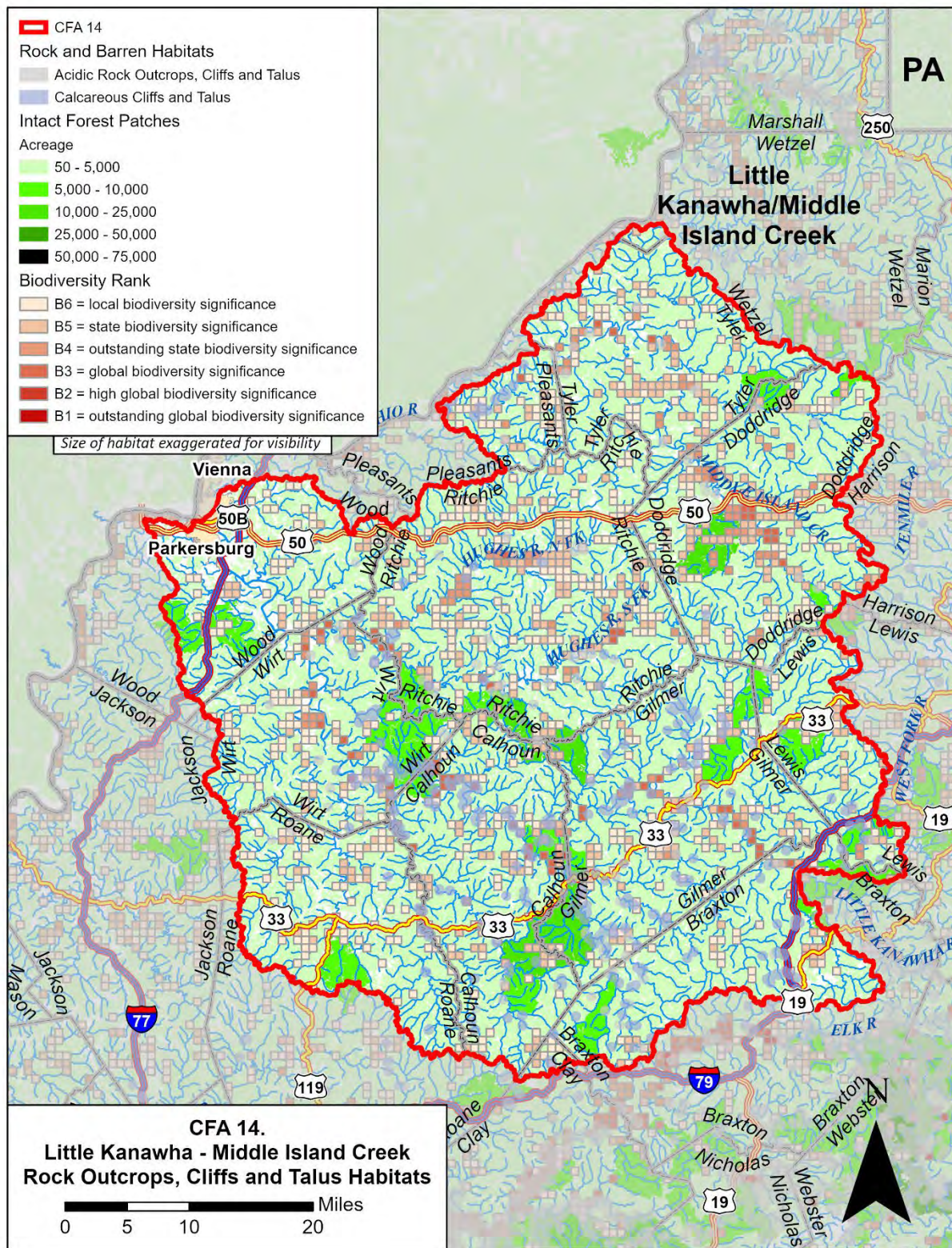
Map 6. Forest and Woodland Habitats



Map 7. Intact Forest Patches and Biodiversity



Map 8. Rock Outcrop, Cliff & Talus Habitats



Habitat Stresses and Conservation Actions

Table 7 lists stresses impacting priority species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses. It is important to note that soils in this CFA are highly susceptible to erosion that can result in significant siltation of streams. Ground disturbance should be minimized and mitigated, particularly in areas with erodible soils.

Table 7. Habitat Stresses and Conservation Actions in Forest and Woodland Habitats

Habitat Stress	Conservation Action
Deforestation, forest fragmentation, poor forest structure and climate change	Maintain and protect contiguous forest cover, structural and spatial complexity
Deforestation and disturbance of rare habitats and hydrological features	Maintain and protect forest cover and hydrology, especially around seeps, streams, rare plants, cliffs, talus, rocky substrates, and other rare habitat features. Follow Forestry BMPs developed by White-Nose Syndrome Response team for bats.
Fragmentation of core forests and increased runoff, erosion and stream sedimentation by shale gas infrastructure	Develop state-level guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests; work with gas companies, county governments and state agencies to minimize habitat and stream impacts
Nonnative invasive species: forest fragmentation, climate change	Maintain forest cover and control nonnative invasive species, especially around rare habitat features
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early successional habitat and structural complexity, including gaps with healthy native grasses, forbs, vegetative cover and snags
Mature forest: deforestation, fragmentation, poor forest structure	Protect mature forest and promote structural complexity: old growth, small openings with well-developed understories, snags and decaying logs
Deer browse impacting forest structure	Manage local deer populations where abundant

Habitat Stress	Conservation Action
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
Road collision/mortality (Eastern Whip-poor-will and Eastern Box Turtles)	Install highway signage in high density areas
Loss of nectar resources and pollinator habitat due to nonnative invasive species and loss of fallow, open areas and native wildflower communities in and adjacent to forested landscapes	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.
Fragmentation of core forests from oil and gas infrastructure and other development	Develop state-level guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests
Incompatible utility corridor management	Improve vegetation management practices in utility corridors

In addition to the habitat-linked stresses listed above, direct stresses to priority species include illegal collection of Eastern Box Turtles and collection along with deliberate killing of Timber Rattlesnakes. In addition, the unknown status of the Mullein Foxglove, Eastern False Rue-anemone, and Basil Mountain-mint plants will require field surveys to determine species distribution and threats.

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

Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et al., 2015) 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, and ecological communities tied to specific hydrological conditions or geologic features may also be unable to migrate. Urban areas and impervious cover can exacerbate the effects of increasing temperatures and heavier precipitation. However, ecosystems within areas of high landscape complexity, including a diversity of topography and microhabitats, may be more able to persist and adapt in response to climate change.

The 2015 assessment also described likely impacts to specific forest types. Dry Mesic Oak Forests support 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 are adapted to heat, drought and fire, and may benefit from climate change. However, droughts may increase susceptibility to forest pests and pathogens, and enable nonnative invasive plants to outcompete native herbs and shrubs, providing additional fuel for fires and increasing fire intensity. Forest pests, pathogens and invasive plants need to be carefully managed to build resilience to climate change.

Mixed Mesophytic Forests may be vulnerable to increasing disturbance by wildfire, drought, and invasion by nonnative plants. These ecosystems may decline in some areas, while sheltered sites in areas of complex topography may provide some refuge from climate change. Drought may increase the susceptibility of these forests to hemlock woolly adelgid, forest tent caterpillar, beech bark disease and other insect pests and diseases. Invasive plants may outcompete native species as conditions change, and drought may increase the risk of wildfire, to which these forests are not well adapted.

The small areas 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.

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

Table 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 herbivory to promote regeneration • Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Promote diversity of native species and age classes through planting and silviculture • Protect habitat refugia for rare plant communities and forest types dependent on unique soils, such as calcareous forests, woodlands, and glades • Protect forest reserves in areas of high biological diversity or priority species • Reduce forest fragmentation • Maintain or restore large patches and corridors of forest habitat • Restore native forest vegetation on degraded lands within and adjacent to forested areas

Implementation Plan

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

Table 9. Implementation Plan for Forest and Woodland Habitats

Action	Partners	Effectiveness Measures
<p>Forest Habitat, Reserve and Corridor 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 • WVDOF Forest Legacy • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
<p>Forest Planning and Management</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 • 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>Develop state-level guidance on siting and construction of shale gas infrastructure to avoid fragmentation of core forests; work with gas companies, county governments and state agencies to minimize habitat and stream impacts</p>	<ul style="list-style-type: none"> • WVDNR • WVDEP • County governments • Shale gas companies 	<ul style="list-style-type: none"> • Acres of core forests with avoided impacts or protected for priority species
<p>Promote diversity of native species and age classes in forested areas, and restore native forest vegetation on adjacent degraded lands through planting and silviculture</p>	<ul style="list-style-type: none"> • WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
<p>Survey and avoid rare plants and snails</p>	<ul style="list-style-type: none"> • WVDOF • Consulting Foresters • Public Land Managers • Oil and Gas • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected/restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Monitor and control nonnative invasive weeds, promptly revegetate disturbed sites	<ul style="list-style-type: none"> • WVDOT • WVCA and GVCD • USDA NRCS • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat protected/restored for priority species • Before and after comparison: abundance and diversity of priority species
Create and maintain pollinator habitat with nectar resources in forest openings	<ul style="list-style-type: none"> • USDA NRCS • WVDOT • USFWS Partners for Wildlife Program • Consulting Foresters • Public Land Managers 	<ul style="list-style-type: none"> • Acres or linear feet of habitat created/maintained • Change in abundance, diversity and distribution of priority species and habitats
Manage deer population where abundant	<ul style="list-style-type: none"> • WVDNR (hunting licenses) • Private landowners • Public Land Managers 	<ul style="list-style-type: none"> • Change in deer population or forest structure • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
<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 <p>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/acre residual basal area)</p>	<ul style="list-style-type: none"> • WVU Extension • USDA NRCS • WVDOT • Consulting Foresters • NWTF and RGS • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • 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: Provide heterogenous stand structure and species diversity with 40-90 ft²/acre 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.</p>	<ul style="list-style-type: none"> • WVU Extension • USDA NRCS • WVDOF • Consulting Foresters • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
<p>Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)</p>	<ul style="list-style-type: none"> • Landowners, partners, and utility companies 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
<p>Provide guidance on timber rattlesnake den avoidance</p>	<ul style="list-style-type: none"> • WVU Extension • Public land managers 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Before and after comparison: abundance, diversity, and distribution of priority species
<p>Install highway signage to avoid collisions with priority species in high density areas</p>	<ul style="list-style-type: none"> • WVDOH • WVDNR 	<ul style="list-style-type: none"> • # signs installed in high density areas

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 for priority species Before and after comparison: abundance, diversity, and distribution of priority species
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> Public Land Managers USDA NRCS WVDEP, WVCA and Conservation Districts WVDNR WVDNR, WVDOP 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 and opportunities for forest carbon sequestration, hunting, wildlife viewing, tourism and recreation.

Aquatic, Floodplain and Riparian Habitats

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

Priority Species

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

Table 14. Priority Species in Aquatic Habitats

Taxa	Scientific Name	Common Name
Fish	<i>Ammocrypta pellucida</i>	Eastern Sand Darter
Fish	<i>Chrosomus erythrogaster</i>	Southern Redbelly Dace
Fish	<i>Etheostoma tippecanoe</i>	Tippecanoe Darter
Fish	<i>Ichthyomyzon bdellium</i>	Ohio Lamprey
Fish	<i>Ichthyomyzon greeleyi</i>	Mountain Brook Lamprey
Fish	<i>Ictiobus cyprinellus</i>	Bigmouth Buffalo
Fish	<i>Ictiobus niger</i>	Black Buffalo
Fish	<i>Lethenteron appendix</i>	American Brook Lamprey
Fish	<i>Notropis boops</i>	Bigeye Shiner
Fish	<i>Percina phoxocephala</i>	Slenderhead Darter
Fish	<i>Polyodon spathula</i>	Paddlefish
Mussels	<i>Epioblasma triquetra</i>	Snuffbox
Mussels	<i>Fusconaia subrotunda</i>	Long-solid
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut
Mussels	<i>Pleurobema clava</i>	Clubshell
Mussels	<i>Simpsonia ambigua</i>	Salamander Mussel

Table 15. Priority Species in Riparian and Floodplain Habitats

TAXA	SCIENTIFIC NAME	COMMON NAME
Amphibians	<i>Cryptobranchus alleganiensis</i>	Eastern Hellbender
Amphibians	<i>Necturus maculosus</i>	Mudpuppy
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Ardea herodias</i>	Great Blue Heron
Birds	<i>Geothlypis formosa</i>	Kentucky Warbler
Birds	<i>Megaceryle alcyon</i>	Belted Kingfisher
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush
Birds	<i>Ardea herodias</i>	Great Blue Heron
Birds	<i>Butorides virescens</i>	Green Heron
Dragonflies and Damselflies	<i>Celithemis fasciata</i>	Banded Pennant
Dragonflies and Damselflies	<i>Enallagma vesperum</i>	Vesper Bluet
Dragonflies and Damselflies	<i>Gomphurus fraternus</i>	Midland Clubtail
Dragonflies and Damselflies	<i>Phanogomphus quadricolor</i>	Rapids Clubtail
Dragonflies and Damselflies	<i>Sympetrum ambiguum</i>	Blue-faced Meadowhawk
Mammals	<i>Myotis septentrionalis</i>	Northern Myotis
Plants	<i>Enemion biternatum</i>	Eastern False Rue-anemone
Plants	<i>Dasistoma macrophylla</i>	Mullein Foxglove
Plants	<i>Potamogeton tennesseensis</i>	Tennessee Pondweed
Reptiles	<i>Apalone spinifera spinifera</i>	Eastern Spiny Softshell
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle
Reptiles	<i>Apalone spinifera spinifera</i>	Eastern Spiny Softshell
Reptiles	<i>Graptemys ouachitensis</i>	Ouachita Map Turtle

Rare Plant Communities

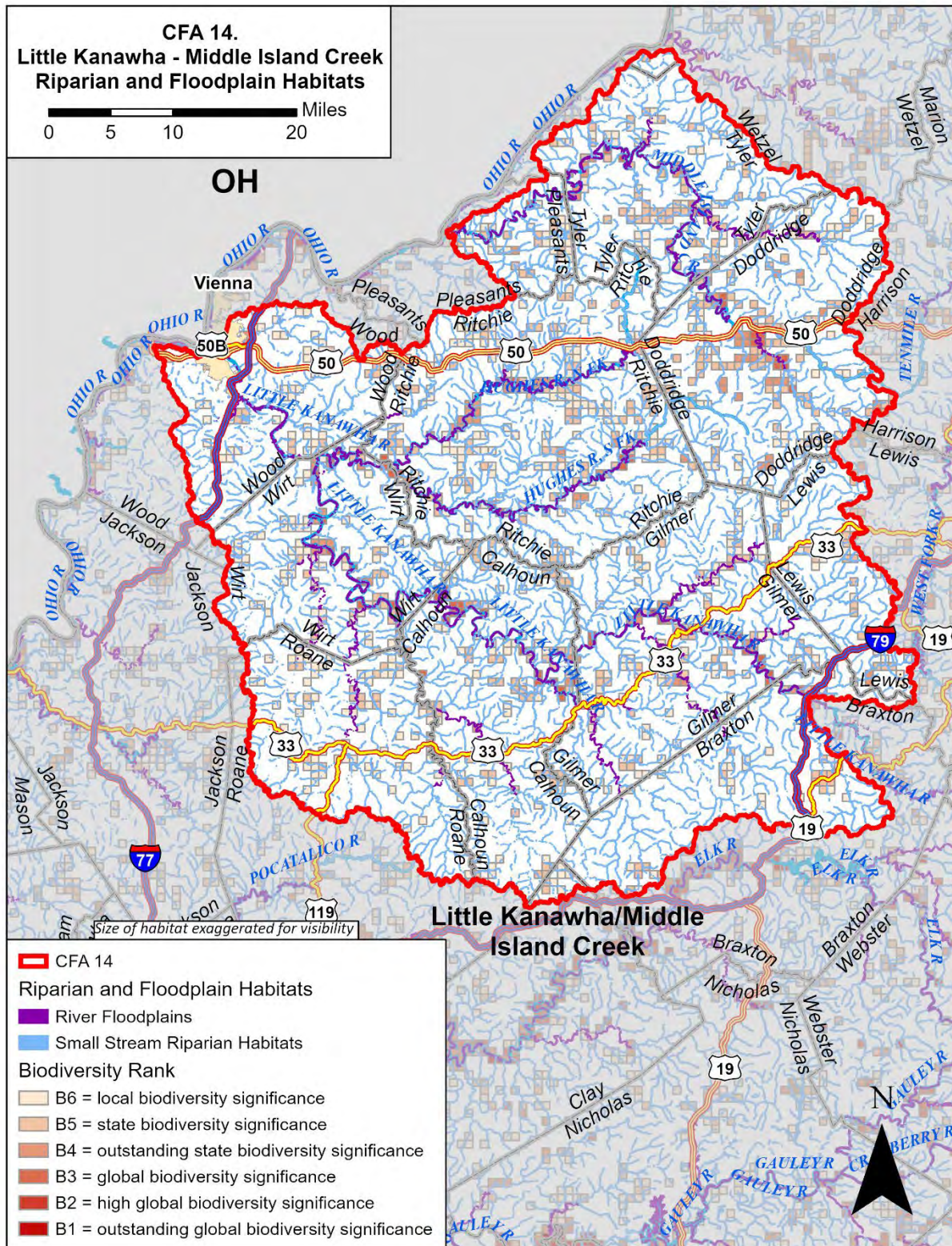
The following rare plant communities may be found in aquatic, floodplain and riparian habitats in this CFA. Note that nearly half of the state's Pondweed – Mixed Aquatic Riverbed plant community is found in this CFA. These plant communities are vulnerable to disturbance and the spread of nonnative invasive plants. Disturbance should be avoided, and nonnative invasive plant infestations should be treated.

Table 16. Rare Plant Communities in Aquatic, Floodplain and Riparian Habitats.

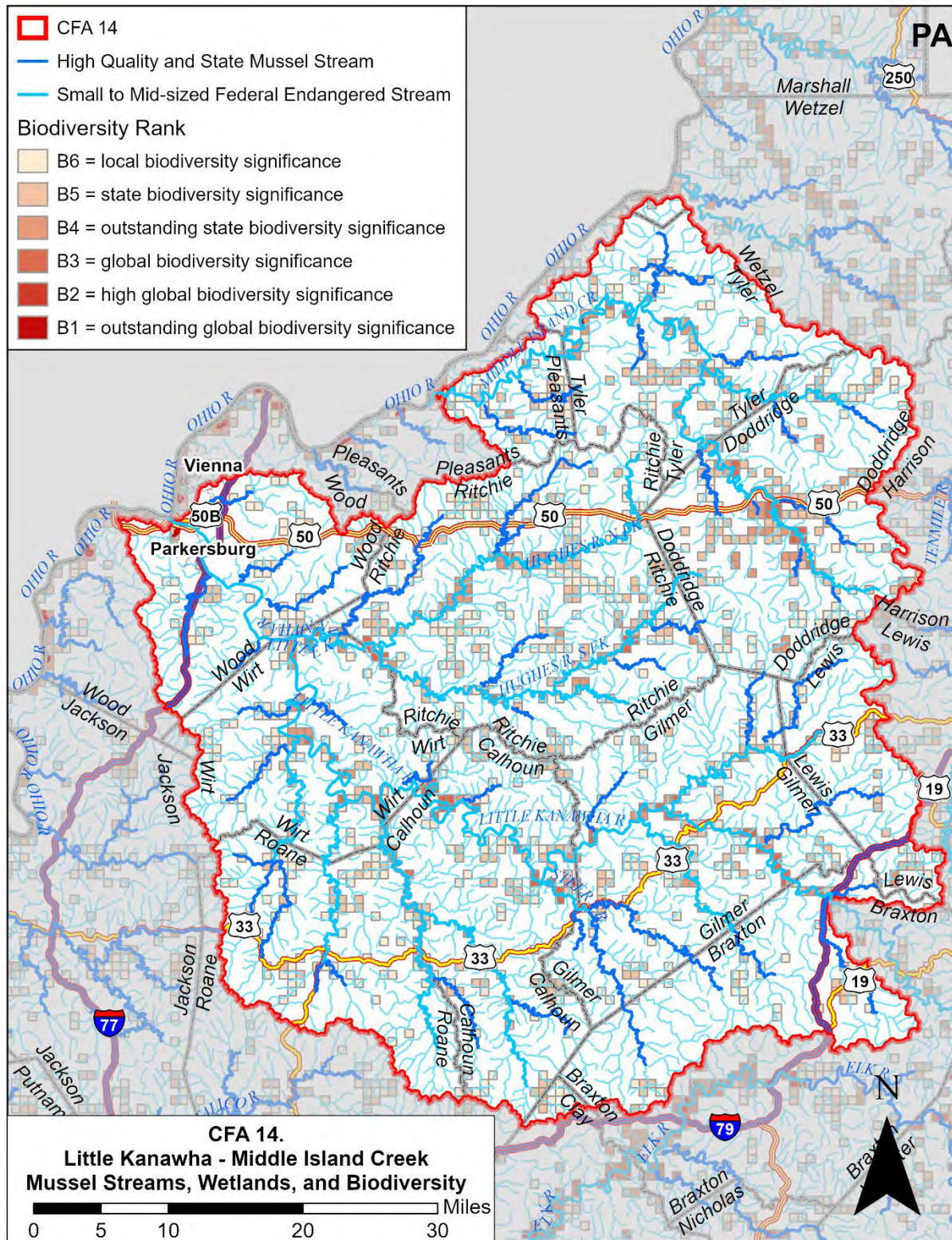
Common Name	Relative Abundance	G Rank	S Rank
Pondweed - Mixed Aquatic Riverbed	42%	G4?	S2
Ohio River Oak Swamp	21%	G3G4	S2

Map 9 and 10 illustrate riparian and floodplain habitats, 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 B-Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats. River floodplain habitats occur along the Little Kanawha River and major tributaries in the southern portion of the CFA and along Middle Island Creek and its major tributaries in the north. Small stream riparian habitats occurring along numerous smaller streams. Three exemplary wetlands can be found in the CFA, two of which can be found near Parkersburg in the west, while another is found in the north along a portion of Middle Island Creek. Various streams throughout the CFA are designated State Mussel Streams, including Tucker Creek, Worthington Creek, the left and right fork of Steer Creek as well as the left, right and middle forks of Reedy Creek, and Tygart Creek. Numerous tributaries of those streams are categorized as small to mid-sized rivers for federally endangered mussel species, including Clubshell, Snuffbox and Rayed Bean. Aquatic and riparian habitats outside of larger forest patches may be more vulnerable to stresses.

Map 9. Riparian and Floodplain Habitats



Map 10. Mussel Streams, Wetlands and Biodiversity



CFA 14

Impaired Streams (2016)

Biodiversity Rank

- B6 = local biodiversity significance
- B5 = state biodiversity significance
- B4 = outstanding state biodiversity significance
- B3 = global biodiversity significance
- B2 = high global biodiversity significance
- B1 = outstanding global biodiversity significance

CFA 14.
Little Kanawha - Middle Island Creek
Impaired Streams and Biodiversity

0 5 10 20 Miles

Habitat Stresses and Conservation Actions

Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly and plant species. Direct stresses to priority species include human disturbances at Green and Great Blue Heron breeding sites, the illegal collection of Eastern Box Turtles. Mudpuppies and Eastern Hellbenders are persecuted and killed by anglers. Eastern Hellbenders are also impacted by illegal collections, and rock piling. These stresses can be addressed by enforcing closed seasons, education of anglers and local communities, and increased surveying at known sites. The status of several rare plants species is unknown, and additional field surveying will be required to determine their distribution and threats.

Map 11 shows stream impairments (WVDEP, 2016), along with biodiversity. Numerous streams within the CFA are impaired by a variety of sources, the most common of which include bio, fecal/bacteria and iron. Lynch Run in the southeast of the CFA is one of the most heavily impaired streams present, suffering from at least four known impairments; bio, fecal/bacteria, iron and manganese. A table with a list of all impaired streams and their causes can be found in Appendix 4. Many of these impaired streams host clusters of biodiversity and provide habitat for mussels and other priority species. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present.

In addition to the listed water quality impairments, very low minimum flows below North Bend Dam may prolong drought conditions. Resulting low flows, low dissolved oxygen levels and high temperatures may harm aquatic life.

Table 17. Habitat Stresses and Conservation Actions for Aquatic, Floodplain and Riparian Habitat

Habitat Stress	Conservation Action
Lack of protected floodplain, wetland, pond, shoal, island, sandbar, riparian and upland stream valley habitat	Habitat protection through land use planning, conservation easements, planting and maintaining forested buffers, and other programs and activities
Water quality degradation (point and non-point source pollution, sedimentation, wastewater, dredging)	Pollution control, improved sewage treatment, storm water management, sediment load reductions, plant and protect riparian buffers
Very low flows below North Bend Dam that may harm aquatic life	Partner with WVDEP and WVDNR to identify causes and impacts of low flows, and develop corrective strategies
Potential for spills containing brine and other hazardous materials into aquatic ecosystems	Develop hazard spill prevention and response protocol to protect aquatic ecosystems and priority species

Habitat Stress	Conservation Action
Water withdrawals and sedimentation by shale gas development activities	Increased coordination with shale gas companies, WVDNR and WVDEP to minimize disturbance, control sediment, develop and implement sustainable water use protocol for streams, and implement Unconventional Oil & Gas BMPs
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
River channelization, stream bank erosion, disconnection of river and floodplain hydrology and habitats	Restore and protect floodplain, riparian, stream bank, channel, island, shoal and sandbar habitats and functions
Nonnative invasive plants	Treating of cattail and other invasive plants
Deforestation, disturbance and runoff from agriculture, shale gas development	Increased coordination with WVDNR and WVDEP, maintain forested riparian corridors, minimize disturbance, control invasive plants and runoff
Riparian habitat disturbance to rare plants	Survey and avoid disturbance to rare plants, landowner outreach, maintain forested riparian corridors
Boat wakes and recreation on sandy beaches used by turtles for nesting; trash attracts carnivores and increases predation	Reduce boat wakes, recreation and littering on sandy beaches, conduct trash cleanups
Aquatic passage barriers	Modify or remove barriers
Degradation of wetlands	Maintain wetland integrity and buffers
Isolated and reduced populations of mussels	Explore stocking

Climate Change and Habitat Resilience

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

climate change. Restoring and maintaining the health, acreage and connectivity of native riparian forests along streams and rivers will build their resilience to climate change.

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

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

Table 18 provides a summary of climate stresses on aquatic, floodplain and riparian habitat, and actions to boost their resilience (Swanston et. al, 2016). While climate stresses are listed separately, aquatic, floodplain and riparian habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions reiterate previously listed conservation actions to reduce stress on priority species and could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 18. 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 19. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <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 WVDOF Forest Legacy WVDNR 	<ul style="list-style-type: none"> Acres/miles of habitat protected for priority species Abundance and diversity of priority species and habitats
Habitat Protection <ul style="list-style-type: none"> Incentive Programs 	<ul style="list-style-type: none"> USDA NRCS 	<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 Hazardous Spill and Prevention Planning 	<ul style="list-style-type: none"> Local governments WVDEP WVDOH WVDNR Shale gas companies 	<ul style="list-style-type: none"> Acres or miles of habitat protected through planning, floodplain and stormwater regulations
Coordination with shale gas companies, WVDNR and WVDEP to minimize ground disturbance, control sediment, develop and implement sustainable water use protocol for streams, and implement Unconventional Oil & Gas BMPs	<ul style="list-style-type: none"> Shale gas companies Local governments WVDEP WVDNR 	<ul style="list-style-type: none"> Acres or miles of habitat protected
Identify causes and impacts of low flows below North Bend Dam, and develop corrective strategies	<ul style="list-style-type: none"> WVDNR WVDEP 	<ul style="list-style-type: none"> Acres or linear feet of in-stream habitat restored for priority species Before and after comparison: water quality parameters, abundance and diversity of priority species
In-stream and riparian habitat restoration (including floodplain reconnection, island, shoal and sandbar habitats)	<ul style="list-style-type: none"> USDA NRCS USDA FSA USFWS Partners for Fish and Wildlife Public Land Managers 	<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 riparian buffer zones around streams, wetlands and ponds	<ul style="list-style-type: none"> USDA NRCS USDA FSA USFWS Partners for Fish and Wildlife WVDOF WVDEP and WVCA 	<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

Action	Partners	Effectiveness Measures
Remove or improve aquatic passage barriers	<ul style="list-style-type: none"> • USFWS Partners for Fish and Wildlife • WVDOH 	<ul style="list-style-type: none"> • # barriers removed • # miles stream opened • Before and after comparison: abundance and diversity of priority species
Improved wastewater and stormwater treatment	<ul style="list-style-type: none"> • WVDEP • WVDHHR • County governments 	<ul style="list-style-type: none"> • # wastewater and stormwater systems installed or improved • Change in water quality measurements • Before and after comparison: abundance & distribution of priority species
Improve water quality in streams and wetlands	<ul style="list-style-type: none"> • WVDEP and WVCA • USDA NRCS • USDA FSA 	<ul style="list-style-type: none"> • Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Minimize riparian and in-stream disturbance and water withdrawals, implement Unconventional Oil & Gas BMPs and sediment controls	<ul style="list-style-type: none"> • WVDEP • WVDNR • Oil and Gas companies 	<ul style="list-style-type: none"> • Before and after comparison: abundance and diversity of priority species
Monitor and carefully treat nonnative invasive plants	<ul style="list-style-type: none"> • USDA NRCS • USDA FSA • 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

Action	Partners	Effectiveness Measures
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> • Local communities and organizations • Public Land Managers • USDA NRCS • USFWS • WV Rivers Coalition • WVCA and Conservation Districts • WVDEP, WVDNR, WVDOF • WVU Extension 	<ul style="list-style-type: none"> • # of people involved in outreach activities • # of people involved in restoration and protection activities

Human Benefits

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

Agricultural and Developed Habitats

Many species of wildlife rely on agricultural lands, especially pastures and woody vegetation in fallow areas, abandoned fields, field borders, wetlands, and riparian corridors. Some species even rely on habitat in more developed lands in residential and urban areas. Map 12 shows the location of agricultural and developed habitats and illustrates many examples of biodiversity occurrences in and around these areas. Agricultural areas can be found throughout the CFA with some heavier groupings found in the west. Developed lands are equally as widespread, with more concentrated areas found around large cities such as Parkersburg and along major roadways such as highways 50 and 33. Maintaining pastures, fallow fields, woody vegetation, wetlands, and riparian corridors is a priority for SGCN in agricultural habitats.

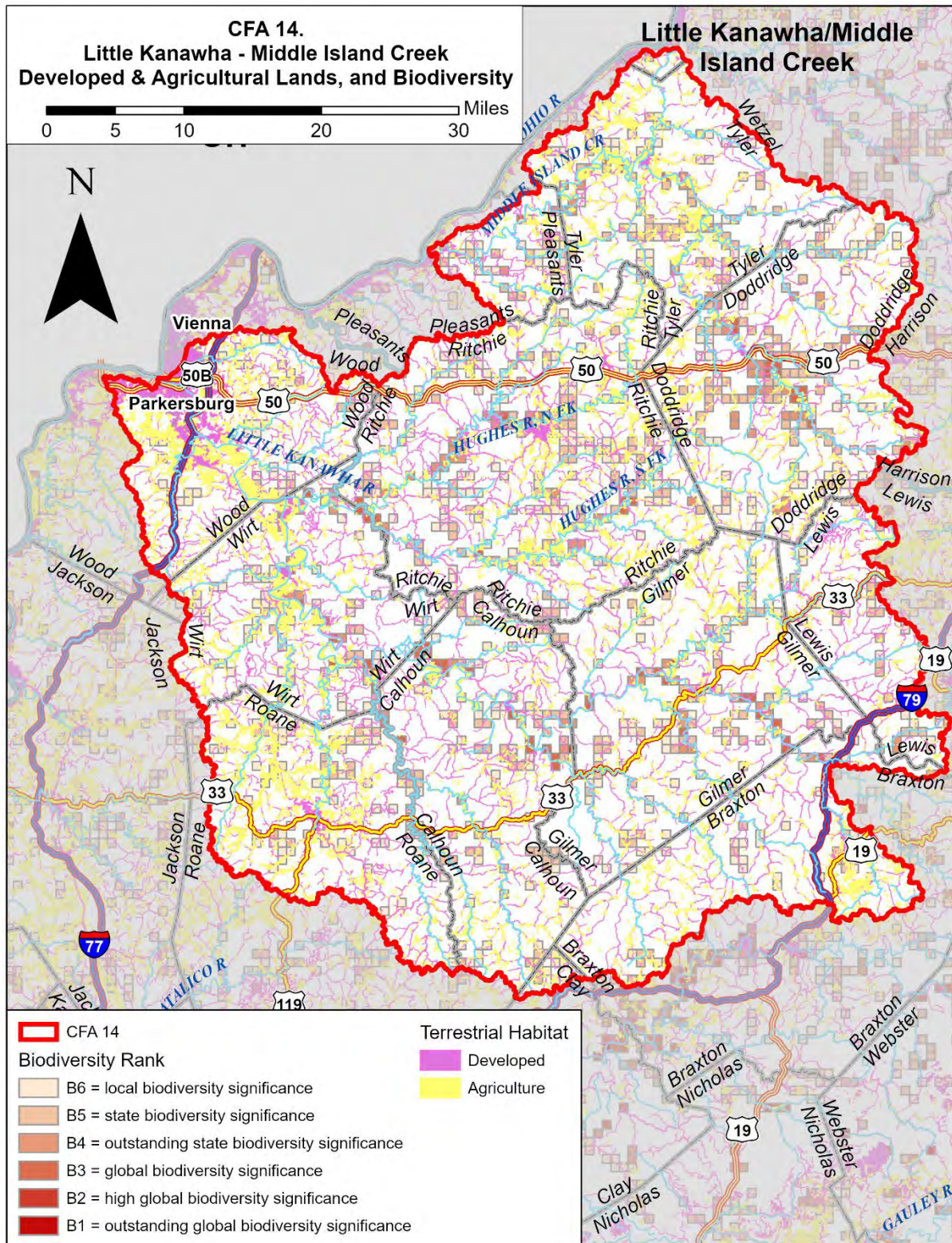
Priority Species

Agricultural lands including cultivated crops, pastures, and hayfields, 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 grassland bird species in the CFA. The following is a list of priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habitat, most notably for the Chimney Swift.

Table 20. Priority Species in Agricultural and Developed Habitats

Taxa	Scientific Name	Common Name
Birds	<i>Chaetura pelagica</i>	Chimney Swift
Birds	<i>Scolopax minor</i>	American Woodcock
Birds	<i>Spizella pusilla</i>	Field Sparrow
Birds	<i>Sturnella magna</i>	Eastern Meadowlark

Map 12. Developed & Agricultural Lands, and Biodiversity



Habitat Stresses and Conservation Actions

The conversion of farmland for residential and commercial development 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 agriculture. Consequently, much natural vegetation providing wildlife habitat in grasslands, wetlands, fallow areas, riparian corridors, hedgerows, and forest edges has been cleared. The timing of agricultural practices also impacts some priority species. For example, early haying impacts ground nesting birds. Many SGCN also rely on habitat created by utility corridors, where the cutting of vegetation or herbicide treatment can have direct impacts on native birds and their nests. Rodenticides used to kill pests may also harm Barn Owls and other birds of prey. Table 21 lists stresses to wildlife habitat in agricultural areas, and conservation actions to address them.

Table 21. 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 veg., bird breeding and roosting sites	Retain or plant shrubs, hedgerows, and hawthorns in pastures; retain and improve grasslands
Failure of bird nesting due to incompatible haying practice	Adjust timing of hay harvest
Loss of early successional habitat in and around agricultural land	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, protect migration roosts
Loss of bird habitat and nesting sites	Landowner outreach and education

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 and 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 22 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 22. 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 23. Implementation Plan for Agricultural and Developed Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: <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 • WVDNR 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection <ul style="list-style-type: none"> • Incentive Programs 	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants	<ul style="list-style-type: none"> • USDA FSA & NRCS • WVCA and Conservation Districts • USFWS Partners for Fish and Wildlife Program 	<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
Create early successional habitat	<ul style="list-style-type: none"> • USDA NRCS • Public Land Managers 	<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

Action	Partners	Effectiveness Measures
Create and maintain pollinator habitat and nectar resources, including native and non-invasive flowering forbs, shrubs, trees, larval host plants and nesting and overwintering areas along field edges, woodlots, water bodies, roads, fallow fields, other appropriate sites	<ul style="list-style-type: none"> • USDA NRCS • WVDOH • USFWS Partners for Wildlife Program 	<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
Adjust timing of hay harvest	<ul style="list-style-type: none"> • USDA FSA 	<ul style="list-style-type: none"> • Acres of hay fields under adjusted schedule • 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"> • USDA FSA • USDA NRCS • Public Land Managers 	<ul style="list-style-type: none"> • Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Adapt farm practices, infrastructure and land uses to changing conditions	<ul style="list-style-type: none"> • USDA FSA • USDA NRCS • Public Land Managers 	<ul style="list-style-type: none"> • # practices or acres adapted • 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 	<ul style="list-style-type: none"> • # chimneys uncapped • # swift towers installed • Change in abundance, diversity, and distribution of chimney swifts

Action	Partners	Effectiveness Measures
Public & Landowner Outreach and Demonstration	<ul style="list-style-type: none"> • Local communities and organizations • Public Land Managers • USDA NRCS • USFWS • WV Rivers Coalition • WVCA and Conservation Districts • WVDEP, WVDNR, WVDOF • WVU Extension 	<ul style="list-style-type: none"> • # of people involved in outreach activities • # of people involved in restoration and protection activities

Human Benefits

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

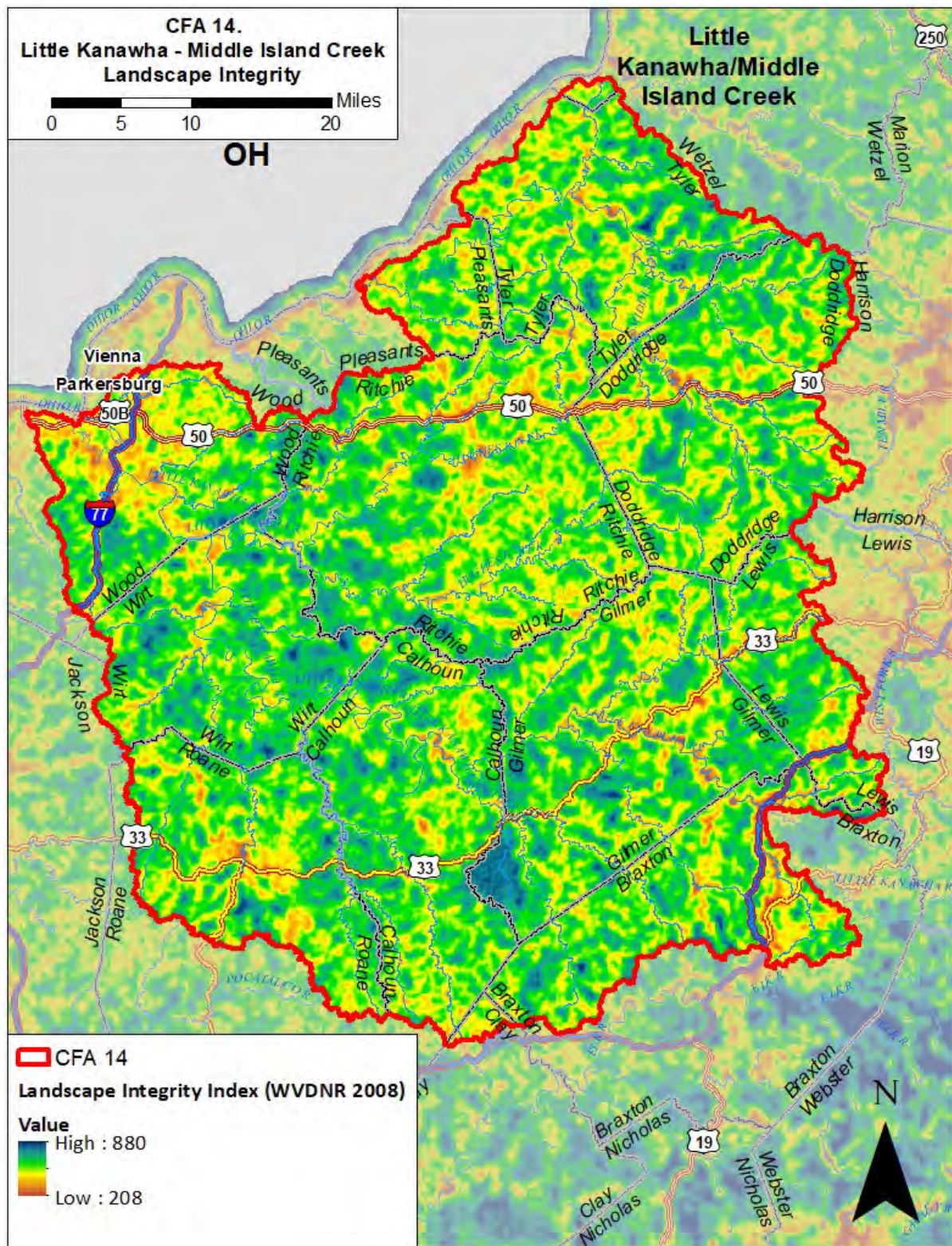
Landscape Resilience and Connectivity

The conservation and resilience actions described previously in this 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 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 cliffs and talus, 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. Map 13 illustrates areas of high landscape integrity in the CFA. Landscape integrity is estimated to increase with distance from roads, powerlines, development, and other features that fragment the landscape. These high integrity landscapes tend to correspond to larger forest patches and most lie within public lands including State Parks and Wildlife Management Areas. There are also landscapes of high integrity in private ownership adjacent to public lands. These areas are important for species movement in response to climate change and are priorities for protection of wildlife habitat.

Map 13. Landscape Integrity



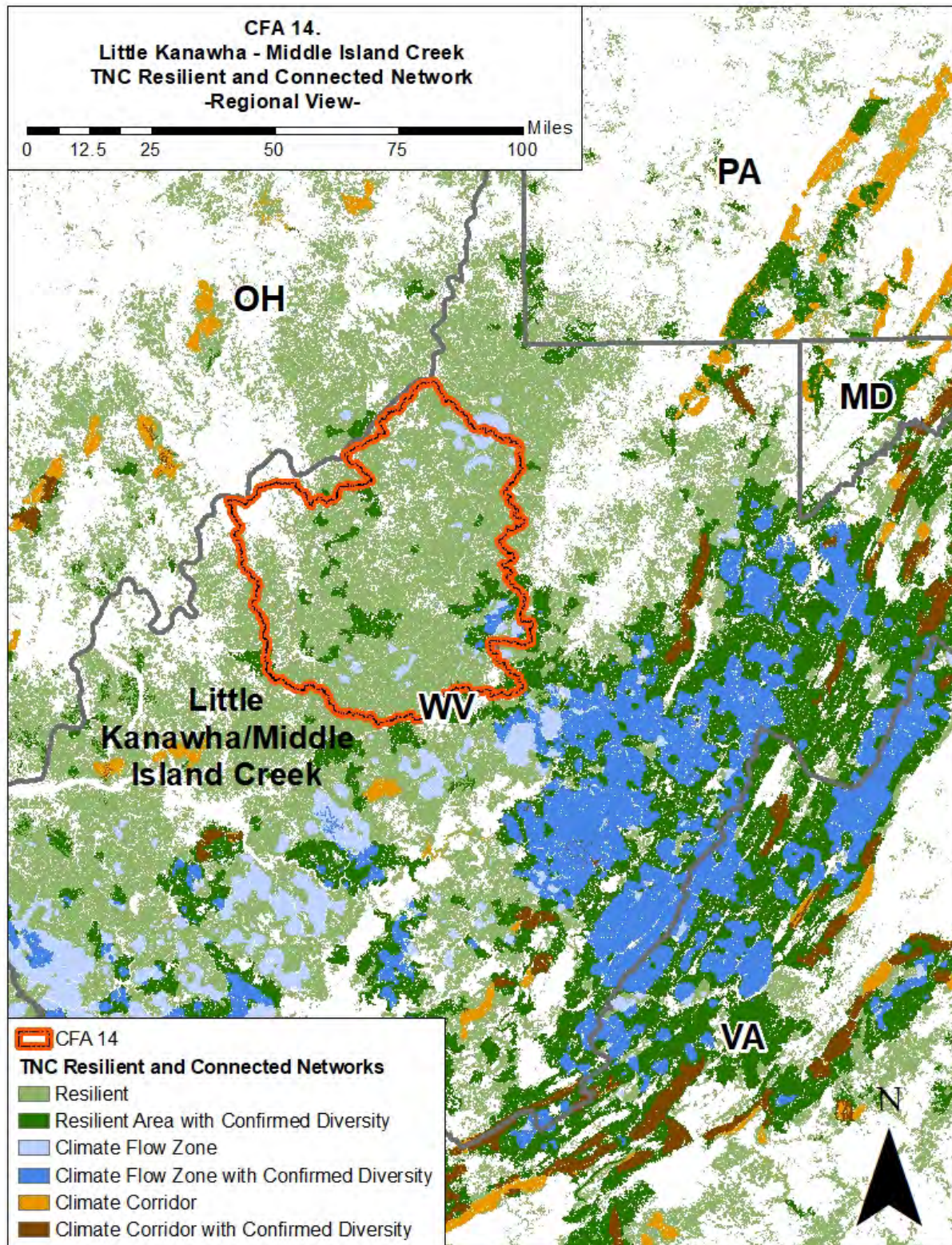
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic 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, and 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 develop 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.

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

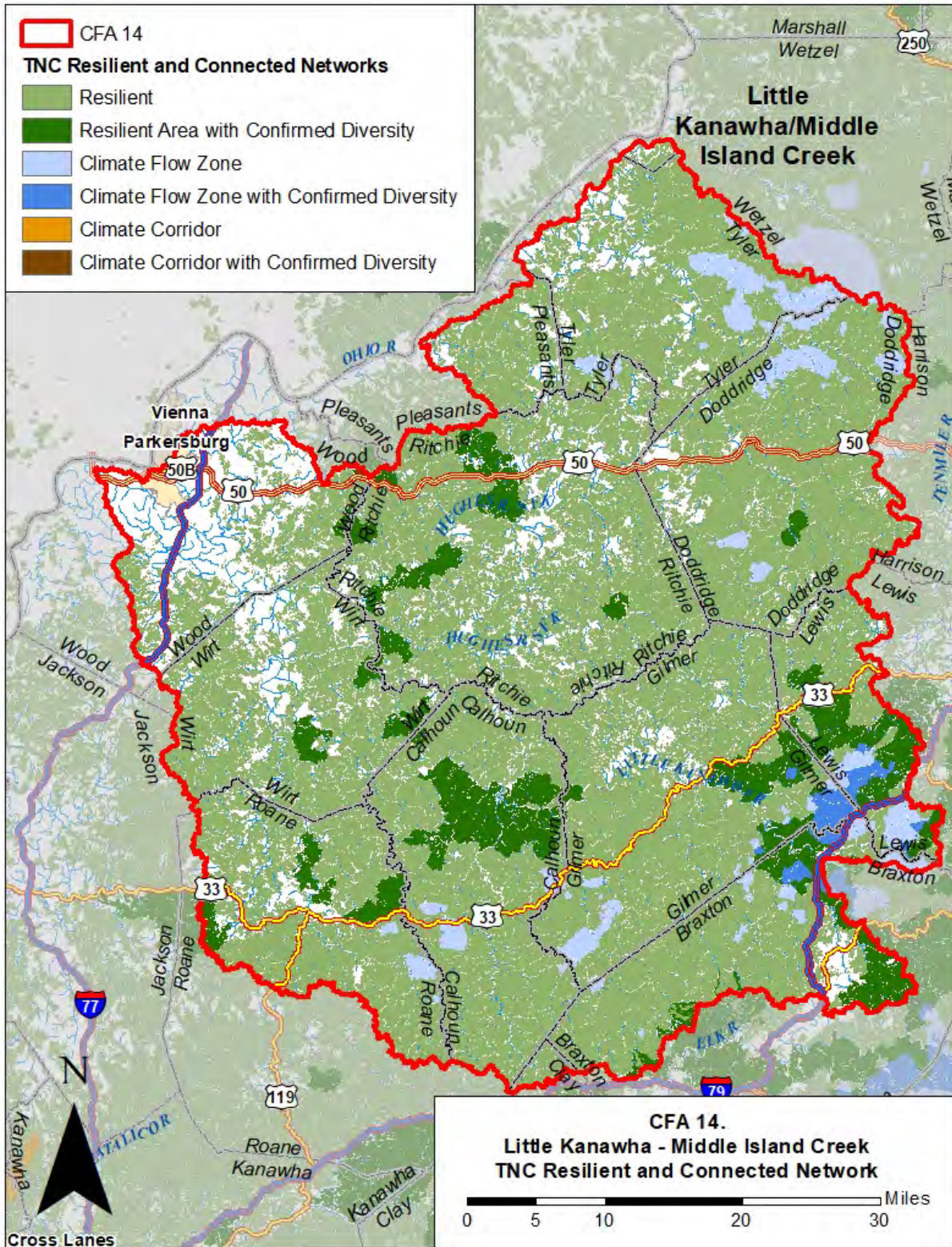
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes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

Map 14 provides a regional map of resilient and connected landscapes and illustrates that the resilient land running through the CFA is part of a larger band of resilient land dominating the western portion of the state. The small patches of resilient land and climate flow zones with confirmed diversity found in the western portion of the CFA are seen to be the beginnings of a large hub of forest blocks, resilient landscapes and flow zones that link the narrower climate corridors both north into Maryland and Pennsylvania and south into Virginia.

Map 14. Resilient and Connected Network – Regional View



Map 15. Resilient and Connected Network – Detailed View



Map 15 provides a detailed view of the resilient, connected landscapes in the Little Kanawha/Middle Island Creek CFA. A large band of resilient land can be seen running through much of the CFA, with a noticeable absence around the Parkersburg area. Smaller patches of resilient land with high diversity are present in the central and eastern regions of the CFA, with smaller patches of climate flow zones within and around the resilient lands. These resilient and connected landscapes contain the CFA's large forest patches and high integrity areas, most of the CFA's rock outcrop, cliff and talus, and known biodiversity.

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

Climate Stresses and Conservation Actions

Table 24 summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Table 24. 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 25. Implementation Plan for Landscape Resilience and Connectivity

Action	Partners	Effectiveness Measures
<p>Protection of Resilient, Connected Landscapes</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>Forest Planning and Management</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 Agricultural & Forestry Activities 	<ul style="list-style-type: none"> • AFF • AFTS, FSC, SFI • 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>Protection of Resilient, Connected Landscapes</p> <ul style="list-style-type: none"> • Conservation, Restoration and Management 	<ul style="list-style-type: none"> • AFF, AMJV, NWTF, RGS, TNC • Forest Certification Programs: ATFS, FSC, SFI • WVDNR • WVDOF • Private Landowners • Public Land Managers • Partner Organizations 	<ul style="list-style-type: none"> • Acres of habitat protected, restored, and maintained in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats

Conclusion

Habitat Conservation Priorities

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

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

- Large, intact forest patches, including interior forest habitat
- Early successional forest habitat
- Small areas of unique, geologically derived habitat including:
 - Acidic rock outcrops, cliffs and talus
 - Calcareous cliffs and talus
- Special aquatic habitats, such as mussel streams and wetlands
- 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

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 cliff and talus habitats may benefit additional species. Private landowners, public land managers and conservation partners are encouraged to focus resources across priority habitats to maximize benefits to multiple species.

Connecting Conservation Actions for Climate Resilience

As we have seen, conservation actions to relieve stresses on priority species and efforts to boost the resilience of wildlife habitat are essential for enabling climate adaptation. Maintaining and protecting areas of high landscape integrity as well as the regional network of resilient lands, climate corridors, and flow zones is also critical for enabling wildlife species to adapt to changing conditions and shift across the landscape.

Furthermore, creating local networks of connected habitat cores and corridors will enhance their resilience and connectivity, and the ability of wildlife species to adapt to changing conditions within this CFA. Connected local networks of headwater streams and larger rivers, their riparian corridors, floodplains, and wetlands enhances the stability of these habitats and enables fish, reptiles, birds, and other priority wildlife species that depend on those habitats to move across the landscape as conditions change. Maintaining connections between patches of diverse forest habitat and with rare cliff and talus habitat 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 even beyond protecting the regional network of climate connectors and flow zones, stakeholders are encouraged to restore and protect the connections between these areas in order to maintain an interwoven fabric of natural systems for wildlife within this CFA to thrive long into the future.

Next Steps in Implementation

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

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

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

References

Association of Fish and Wildlife Agencies. 2011. Measuring the Effectiveness of State Wildlife Grants: Final Report. 178 pp. http://www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf

Anderson, M.G., M. Clark, C.E. Ferec, A. Jospe, A. Olivero Sheldon, and K.J. Weaver. 2013. Northeast Habitat Guides: A companion to the terrestrial and aquatic habitat maps. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. <http://naturel.ly/HabitatGuide>

Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, J. Prince. 2016a. Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. http://easterndivision.s3.amazonaws.com/Resilient_Sites_for_Terrestrial_Conservation.pdf

Anderson, M.G., A. Barnett, M. Clark, J. Prince, A. Olivero Sheldon, and B. Vickery. 2016b. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. http://easterndivision.s3.amazonaws.com/Resilient_and_Connected_Landscapes_For_Terrestrial_Conservation.pdf

Butler, Patricia R.; Iverson, Louis; Thompson, Frank R., III; Brandt, Leslie; Handler, Stephen; Janowiak, Maria; Shannon, P. Danielle; Swanston, Chris; Karriker, Kent; Bartig, Jarel; Connolly, Stephanie; Dijak, William; Bearer, Scott; Blatt, Steve; Brandon, Andrea; Byers, Elizabeth; Coon, Cheryl; Culbreth, Tim; Daly, Jad; Dorsey, Wade; Ede, David; Euler, Chris; Gillies, Neil; Hix, David M.; Johnson, Catherine; Lyte, Latasha; Matthews, Stephen; McCarthy, Dawn; Minney, Dave; Murphy, Daniel; O'Dea, Claire; Orwan, Rachel; Peters, Matthew; Prasad, Anantha; Randall, Cotton; Reed, Jason; Sandeno, Cynthia; Schuler, Tom; Sneddon, Lesley; Stanley, Bill; Steele, Al; Stout, Susan; Swaty, Randy; Teets, Jason; Tomon, Tim; Vanderhorst, Jim; Whatley, John; Zegre, Nicholas. 2015. Central Appalachians forest ecosystem vulnerability assessment and synthesis: a report from the Central Appalachians Climate Change Response Framework project. U.S.D.A. Forest Service, Northern Research Station, General Technical Report NRS-146. Newtown Square, PA. 310 p. <https://doi.org/10.2737/NRS-GTR-146>.

Byers, E. and S. Norris. 2011. Climate change vulnerability assessment of species of concern in West Virginia. Project report to the West Virginia Division of Natural Resources, Elkins, WV. 69 pg. <https://www.wvdnr.gov/publications/PDFFiles/ClimateChangeVulnerability.pdf>

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia. <http://www.natureserve.org/library/usEcologicalsystems.pdf>

Gawler, S.C. 2008. Northeastern Terrestrial Wildlife Habitat Classification. Report to the Virginia Department of Game and Inland Fisheries on behalf of the Northeast Association of Fish and Wildlife Agencies and the National Fish and Wildlife Foundation. NatureServe, Boston, Massachusetts. 102 pp.

Harrison, Laura and Odell, Simon. 2016. Connectivity and ecological networks: Technical Information Note 01/2016. Research Report. The Landscape Institute, White Rose, U.K.

[https://eprints.whiterose.ac.uk/106609/1/Landscape Institute 2016 Connectivity and Ecological Networks.pdf](https://eprints.whiterose.ac.uk/106609/1/Landscape%20Institute%202016%20Connectivity%20and%20Ecological%20Networks.pdf)

Homer, C., C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, vol. 170, No. 7, July 2004, pp. 829-840.

Janowiak, M., D. Dostie, M. Wilson, M. Kucera, R. Howard Skinner, J. Hatfield, D. Hollinger, and C. Swanston. 2016. Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. Technical Bulletin 1944. Washington, DC: U.S. Department of Agriculture.

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

Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. Climate-Smart Conservation: Putting Adaptation Principles into Practice. National Wildlife Federation, Washington, D.C.

https://www.nwf.org/-/media/PDFs/Global-Warming/2014/Climate-Smart-Conservation-Final_06-06-2014.ashx

Swanston, C., M. Janowiak, L. Brandt, P. Butler, S. Handler, P. Shannon, A. Lewis, K. Hall, R. Fahey, L. Scott, A. Kerber, J. Miesbauer, L. Darling, L. Parker and M. St. Pierre. 2016. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers, 2nd edition. USDA Forest Service, Northern Research Station, General Technical Report NRS-87-2. Newtown Square, PA.

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

USDA Natural Resources Conservation Service. 2004. National Biology Handbook, Subpart B- Conservation Planning. Part 613: Conservation Corridor Planning at the Landscape level- Managing for Wildlife Habitat. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_009912.pdf

West Virginia Division of Natural Resources. 2015. 2015 West Virginia State Wildlife Action Plan.

<http://www.wvdnr.gov/2015%20West%20Virginia%20State%20Wildlife%20Action%20Plan%20Submission.pdf>

Appendix 1. SGCN in the Middle Island Creek and Little Kanawha CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Amphibians	Ambystoma jeffersonianum	Jefferson Salamander	S2	G4		
Amphibians	Aneides aeneus	Green Salamander	S3	G3G4	—	
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3G4	—	
Amphibians	Lithobates pipiens (R. pipiens)	Northern Leopard Frog	S1	G5	—	
Amphibians	Necturus maculosus	Mudpuppy	S4	G5	—	
Amphibians	Plethodon wehrlei	Wehrle's Salamander	S4	G4		
Amphibians	Pseudotriton montanus diastictus	Midland Mud Salamander	S1	G5T5		
Amphibians	Pseudotriton ruber ruber	(northern) Red Salamander	S3	G5		
Amphibians	Scaphiopus holbrookii	Eastern Spadefoot	S1	G5	—	
Birds	Actitis macularius	Spotted Sandpiper	S2B	G5		
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5	R	
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5		At Risk Conserv
Birds	Ardea herodias	Great Blue Heron	S3B,S4N	G5		
Birds	Bonasa umbellus	Ruffed Grouse	S3B,S3N	G5	R	
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5		
Birds	Butorides virescens	Green Heron	S3B	G5		
Birds	Chaetura pelagica	Chimney Swift	S3B	G5	—	
Birds	Chordeiles minor	Common Nighthawk	S2B	G5	R	
Birds	Coccyzus erythrophthalmus	Black-billed Cuckoo	S2B	G5	—	
Birds	Falco sparverius	American Kestrel	S3B	G5	—	
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5	R	
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5		
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5	R	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Birds	<i>Hylocichla mustelina</i>	Wood Thrush	S3B	G5	R	At Risk Conserv
Birds	<i>Icteria virens</i>	Yellow-breasted Chat	S3B	G5		
Birds	<i>Parkesia motacilla</i>	Louisiana Waterthrush	S3B	G5		
Birds	<i>Petrochelidon pyrrhonota</i>	Cliff Swallow	S3B	G5		
Birds	<i>Piranga rubra</i>	Summer Tanager	S3B	G5	—	
Birds	<i>Rallus limicola</i>	Virginia Rail	S1B,S1N	G5		
Birds	<i>Scolopax minor</i>	American Woodcock	S3B	G5	R	
Birds	<i>Setophaga cerulea</i>	Cerulean Warbler	S2B	G4	—	At Risk Conserv
Birds	<i>Setophaga discolor</i>	Prairie Warbler	S3B	G5	R	
Birds	<i>Spizella pusilla</i>	Field Sparrow	S3B, S3N	G5	R	
Birds	<i>Sturnella magna</i>	Eastern Meadowlark	S3B, S2N	G5	R	
Birds	<i>Vermivora cyanoptera</i>	Blue-winged Warbler	S3B	G5		
Butterflies & Moths	<i>Calycopis cecrops</i>	Red-banded Hairstreak	S3	G5		
Butterflies & Moths	<i>Celastrina neglecta</i>	Appalachian Azure	SNR	G4		
Butterflies & Moths	<i>Cyllopsis gemma</i>	Gemmed Satyr	S3	G4G5		
Butterflies & Moths	<i>Glaucopsyche l. lygdamus</i>	Silvery Blue	S4	G5T3T4		
Butterflies & Moths	<i>Parrhasius m-album</i>	White-m Hairstreak	S2	G5		
Dragonflies & Damselflies	<i>Aeshna tuberculifera</i>	Black-tipped Darner	S3	G4		
Dragonflies & Damselflies	<i>Anax longipes</i>	Comet Darner	S3	G5		
Dragonflies & Damselflies	<i>Celithemis fasciata</i>	Banded Pennant	S3	G5		
Dragonflies & Damselflies	<i>Cordulegaster obliqua</i>	Arrowhead Spiketail	S2	G4		
Dragonflies & Damselflies	<i>Cordulia shurtleffi</i>	American Emerald	S4	G5		
Dragonflies & Damselflies	<i>Dromogomphus spoliatus</i>	Flag-tailed Spinyleg	SH	G4G5		
Dragonflies & Damselflies	<i>Enallagma vesperum</i>	Vesper Bluet	S3	G5		
Dragonflies & Damselflies	<i>Epiaeschna heros</i>	Swamp Darner	S3	G5		
Dragonflies & Damselflies	<i>Gomphus adelphus</i>	Mustached Clubtail	S1	G4		
Dragonflies & Damselflies	<i>Gomphus desertus</i>	Harpoon Clubtail	S2S3	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Dragonflies & Damselflies	Gomphurus fraternus	Midland Clubtail	S2	G5		
Dragonflies & Damselflies	Gomphurus vastus	Cobra Clubtail	S2	G5		
Dragonflies & Damselflies	Helocordulia uhleri	Uhler's Sundragon	S2S3	G5		
Dragonflies & Damselflies	Hylogomphus viridifrons	Green-faced Clubtail	S3	G3G4		
Dragonflies & Damselflies	Ladona deplanata	Blue Corporal	S3	G5		
Dragonflies & Damselflies	Lestes australis	Southern Spreadwing	S3	G5		
Dragonflies & Damselflies	Macromia alleghaniensis	Allegheny River Cruiser	S2S3	G4		
Dragonflies & Damselflies	Macromia illinoensis	Illinois River Cruiser	S3	G5		
Dragonflies & Damselflies	Neurocordulia yamaskanensis	Stygian Shadowdragon	S3	G5		
Dragonflies & Damselflies	Phanogomphus quadricolor	Rapids Clubtail	S3	G3G4		
Dragonflies & Damselflies	Progomphus obscurus	Common Sanddragon	S2S3	G5		
Dragonflies & Damselflies	Somatochlora linearis	Mocha Emerald	S3	G5		
Dragonflies & Damselflies	Stylurus spiniceps	Arrow Clubtail	S2	G5		
Dragonflies & Damselflies	Sympetrum ambiguum	Blue-faced Meadowhawk	S1	G5		
Dragonflies & Damselflies	Sympetrum obtrusum	White-faced Meadowhawk	S3	G5		
Fish	Ameiurus melas	Black Bullhead	S1	G5	—	
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5		
Fish	Ammocrypta pellucida	Eastern Sand Darter	S3	G3	—	
Fish	Carpionodes carpio	River Carpsucker	S3	G5		
Fish	Carpionodes velifer	Highfin Carpsucker	S1	G4G5		
Fish	Chrosomus erythrogaster	Southern Redbelly Dace	S2S3	G5		
Fish	Etheostoma tippecanoe	Tippecanoe Darter	S2	G3G4	—	
Fish	Ichthyomyzon bdellium	Ohio Lamprey	S2S3	G3G4	—	
Fish	Ichthyomyzon greeleyi	Mountain Brook Lamprey	S1	G3G4	—	
Fish	Ictiobus cyprinellus	Bigmouth Buffalo	S1	G5		
Fish	Ictiobus niger	Black Buffalo	S2	G5		
Fish	Lepomis gulosus	Warmouth	S1	G5		
Fish	Lepomis humilis	Orangespotted Sunfish	S1	G5		
Fish	Lethenteron appendix	American Brook Lamprey	S2	G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Fish	<i>Lythrurus umbratilis</i>	Redfin Shiner	S3	G5		
Fish	<i>Macrhybopsis storeriana</i>	Silver Chub	S3	G5		
Fish	<i>Moxostoma carinatum</i>	River Redhorse	S3	G4		
Fish	<i>Notropis boops</i>	Bigeye Shiner	S1	G5		
Fish	<i>Percina copelandi</i>	Channel Darter	S2S3	G4		
Fish	<i>Percina phoxocephala</i>	Slenderhead Darter	S1	G5		
Fish	<i>Percina sciera</i>	Dusky Darter	S3	G5		
Fish	<i>Percina shumardi</i>	River Darter	S1	G5		
Fish	<i>Pimephales vigilax</i>	Bullhead Minnow	S2	G5		
Fish	<i>Polyodon spathula</i>	Paddlefish	S1	G4		
Mammals	<i>Lasionycteris noctivagans</i>	Silver-haired Bat	S2	G5		
Mammals	<i>Lasiurus borealis</i>	Eastern Red Bat	S4	G5	R	
Mammals	<i>Lasiurus cinereus</i>	Hoary Bat	S3	G5	—	
Mammals	<i>Myotis leibii</i>	Eastern Small-footed Bat	S1	G3	—	
Mammals	<i>Myotis lucifugus</i>	Little Brown Myotis	S2*	G3	R	
Mammals	<i>Myotis septentrionalis</i>	Northern Myotis	S2*	G2G3	T	
Mammals	<i>Nycticeius humeralis</i>	Evening Bat	S1	G5		
Mammals	<i>Perimyotis subflavus</i>	Tricolored Bat	S2*	G3	R	
Mammals	<i>Spilogale putorius</i>	Eastern Spotted Skunk	S1	G5	—	
Mussels	<i>Actinonaias ligamentina</i>	Mucket	S3	G5		
Mussels	<i>Alasmodonta marginata</i>	Elktoe	S1	G4	—	
Mussels	<i>Amblema plicata</i>	Threeridge	S3	G5		
Mussels	<i>Anodontoides ferussacianus</i>	Cylindrical Papershell	S2	G5		
Mussels	<i>Cambarunio iris</i>	Rainbow	S2	G5Q		
Mussels	<i>Cyclonaias tuberculata</i>	Purple Wartyback	S1	G5		
Mussels	<i>Elliptio crassidens</i>	Elephant-ear	S2	G5		
Mussels	<i>Epioblasma triquetra</i>	Snuffbox	S2	G3	E	
Mussels	<i>Eurynia dilatata</i>	Spike	S3	G5		
Mussels	<i>Fusconaia flava</i>	Wabash Pigtoe	S1	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Mussels	<i>Fusconaia subrotunda</i>	Long-solid	S3	G3		At Risk Conserv
Mussels	<i>Lampsilis cardium</i>	Plain Pocketbook	S3	G5		
Mussels	<i>Lampsilis fasciola</i>	Wavy-rayed Lampmussel	S3	G5		
Mussels	<i>Lampsilis ovata</i>	Pocketbook	S3	G5		
Mussels	<i>Lasmigona complanata</i>	White Heelsplitter	S3	G5		
Mussels	<i>Lasmigona compressa</i>	Creek Heelsplitter	S1	G5		
Mussels	<i>Lasmigona costata</i>	Fluted-shell	S3	G5		
Mussels	<i>Ligumia recta</i>	Black Sandshell	S3	G5	—	
Mussels	<i>Megaloniaias nervosa</i>	Washboard	S2	G5		
Mussels	<i>Obliquaria reflexa</i>	Threehorn Wartyback	S3	G5		
Mussels	<i>Obovaria subrotunda</i>	Round Hickorynut	S3	G4		
Mussels	<i>Pleurobema clava</i>	Clubshell	S1	G2	E	
Mussels	<i>Paetuliunio fabalis</i>	Rayed Bean	S1	G2	E	
Mussels	<i>Pleurobema sintoxia</i>	Round Pigtoe	S2	G4G5		
Mussels	<i>Potamilus fragilis</i>	Fragile Papershell	S3	G5		
Mussels	<i>Ptychobranhus fasciolaris</i>	Kidneyshell	S3	G4G5		
Mussels	<i>Pyganodon grandis</i>	Giant Floater	S3	G5		
Mussels	<i>Quadrula quadrula</i>	Mapleleaf	S3	G5		
Mussels	<i>Simpsoniaias ambigua</i>	Salamander Mussel	S2	G3		
Mussels	<i>Strophitus undulatus</i>	Squawfoot	S3	G5		
Mussels	<i>Theliderma cylindrica</i>	Rabbitsfoot	SX	G3G4		
Mussels	<i>Theliderma metanevra</i>	Monkeyface	S2	G4		
Mussels	<i>Toxolasma parvus</i>	Lilliput	S2	G5		
Mussels	<i>Tritogonia verrucosa</i>	Pistolgrip	S3	G4G5		
Mussels	<i>Truncilla donaciformis</i>	Fawnsfoot	S1	G5		
Mussels	<i>Truncilla truncata</i>	Deertoe	S2	G5		
Mussels	<i>Utterbackia imbecillis</i>	Paper Pondshell	S2	G5		
Mussels	<i>Villosa lienosa</i>	Little Spectaclecase	S1	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	<i>Calycanthus floridus</i> var. <i>glaucus</i>	Carolina Allspice, Strawberry-shrub	SH	G5T5		
Plants	<i>Carex buxbaumii</i>	Brown Bog Sedge	S2	G5		
Plants	<i>Carex laxiculmis</i> var. <i>copulata</i>	Spreading Sedge	S2	G5T3T5		
Plants	<i>Carex projecta</i>	Necklace Sedge	S3	G5		
Plants	<i>Carex tosa</i> var. <i>tonsa</i>	Shaved Sedge	S1	G5T5		
Plants	<i>Carex typhina</i>	Cattail Sedge	S2	G5		
Plants	<i>Chamaesyce vermiculata</i>	Hairy Spurge	S2	G5		
Plants	<i>Cyperus refractus</i>	Reflexed Flatsedge	S3	G5		
Plants	<i>Cyperus squarrosus</i>	Awed Flatsedge	S3	G5		
Plants	<i>Dasistoma macrophylla</i>	Mullein Foxglove	S2	G4		
Plants	<i>Enemion biternatum</i>	Eastern False Rue-anemone	S1	G5		
Plants	<i>Galactia volubilis</i>	Downy Milkpea	S2	G5		
Plants	<i>Hasteola suaveolens</i>	False Indian-plantain	S3	G4		
Plants	<i>Heteranthera reniformis</i>	Kidneyleaf Mud-plantain	S1	G5		
Plants	<i>Juglans cinerea</i>	Butternut	S3	G4		
Plants	<i>Juncus biflorus</i>	Bog Rush	S2	G5		
Plants	<i>Liatris scariosa</i> var. <i>nieuwlandii</i>	Devil's-bite	S1	G5?T3T5		
Plants	<i>Ludwigia leptocarpa</i>	River Seedbox	S2	G5		
Plants	<i>Lygodium palmatum</i>	American Climbing Fern	S3	G4		
Plants	<i>Matteuccia struthiopteris</i>	Ostrich Fern	S2	G5		
Plants	<i>Myosotis macrosperma</i>	Large-seed Forget-me-not	S3	G5		
Plants	<i>Nuttallanthus canadensis</i>	Old-field Toadflax	S2	G5		
Plants	<i>Oenothera pilosella</i> ssp. <i>pilosella</i>	Meadow Sundrops	S2	G5T5?		
Plants	<i>Paspalum pubiflorum</i>	Hairy-seed Crowngrass	S1	G5		
Plants	<i>Pellaea glabella</i> ssp. <i>glabella</i>	Smooth Cliffbrake	S2	G5T5		
Plants	<i>Potamogeton tennesseensis</i>	Tennessee Pondweed	S2	G2		At Risk- Science

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	<i>Prunus angustifolia</i> var. <i>angustifolia</i>	Chickasaw Plum	S1	G5T4T5		
Plants	<i>Pycnanthemum clinopodioides</i>	Basil Mountain-mint	SH	G2		
Plants	<i>Quercus shumardii</i>	Shumard Oak	S2	G5		
Plants	<i>Rudbeckia fulgida</i> var. <i>fulgida</i>	Orange Coneflower	S2	G5T4?		
Plants	<i>Salix discolor</i>	Pussy Willow	S2	G5		
Plants	<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	Seaside Brookweed	S2	G5T5		
Plants	<i>Schizachne purpurascens</i>	False Melicgrass	S1	G5		
Plants	<i>Silene nivea</i>	Snowy Catchfly	S1	G4?		
Plants	<i>Sparganium androcladum</i>	Branched Bur-reed	S2S3	G4G5		
Plants	<i>Taxus canadensis</i>	Canada Yew	S2S3	G5		
Plants	<i>Thuja occidentalis</i>	Northern White-cedar	S2	G5		
Plants	<i>Trillium flexipes</i>	Nodding Wakerobin	S2	G5		
Plants	<i>Veronica scutellata</i>	Grassleaf Speedwell	S2	G5		
Plants	<i>Xyris torta</i>	Slender Yellow-eyed-grass	S2	G5		
Reptiles	<i>Agkistrodon contortrix mokasen</i>	Northern Copperhead	S5	G5T5		
Reptiles	<i>Apalone spinifera spinifera</i>	Eastern Spiny Softshell	S4	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>Graptemys geographica</i>	Northern Map Turtle	S1	G5	—	
Reptiles	<i>Graptemys ouachitensis</i>	Ouachita Map Turtle	S1	G5		
Reptiles	<i>Heterodon platirhinos</i>	Eastern Hog-nosed Snake	S2	G5	R	
Reptiles	<i>Opheodrys aestivus</i>	Rough Greensnake	S2	G5		
Reptiles	<i>Plestiodon anthracinus anthracinus</i>	Northern Coal Skink	S2	G5T5	—	

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Reptiles	<i>Plestiodon laticeps</i>	Broad-headed Skink	S2	G5	—	
Reptiles	<i>Regina septemvittata</i>	Queen Snake	S4	G5		
Reptiles	<i>Scincella lateralis</i>	Little Brown Skink	S2	G5		
Reptiles	<i>Terrapene carolina carolina</i>	Eastern Box Turtle	S5	G5T5	R	
Reptiles	<i>Thamnophis sauritus</i>	Eastern Ribbonsnake	S2	G5	—	
Reptiles	<i>Virginia valeriae valeriae</i>	Eastern Earthsnake	S2	G5T5		
Snails	<i>Catinella vermeta</i>	Suboval Ambersnail	S3	G5		
Snails	<i>Euchemotrema leai</i>	Lowland Pillsnail	S3	G5		
Snails	<i>Gastrocopta procera</i>	Wing Snaggletooth	S2	G5		
Snails	<i>Gastrodonta interna</i>	Brown Bellytooth	S3	G5		
Snails	<i>Glyphyalinia cumberlandiana</i>	Hill Glyph	S3	G4		
Snails	<i>Hawaiiia alachuana</i>	Southeastern Gem	S3	G4G5Q		
Snails	<i>Inflectarius inflectus</i>	Shagreen	S2	G5		
Snails	<i>Lucilla singleyana</i>	Smooth Coil	S2	G5		
Snails	<i>Mesomphix perlaevis</i>	Smooth Button	S3	G4G5		
Snails	<i>Punctum smithi</i>	Lamellate Spot	S2	G4		
Snails	<i>Striatura ferrea</i>	Black Striate	S3	G5		
Snails	<i>Triodopsis anteridon</i>	Carter Threetooth	S3	G3		
Snails	<i>Triodopsis vulgata</i>	Dished Threetooth	S2	G5		
Snails	<i>Ventridens arcellus</i>	Golden Dome	S3	G4		
Snails	<i>Vertigo milium</i>	Blade Vertigo	S2	G5		
Snails	<i>Webbhelix multilineata</i>	Striped Whitelip	S1	G5		
Snails	<i>Zonitoides elliotti</i>	Green Dome	S2	G4		
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, X = Extirpated, Q = Questionable Taxonomy, S#S# or G#G# indicates range of uncertainty of conservation status. Federal Status: R = Rare, T = Threatened, E = Endangered. USFWS Priority At Risk: Conserv = need management attention, Science = need more research.

Appendix 2. Priority SGCN, Known Stresses and Actions

Forests and Woodlands		
Common Name	Local Stress	Action
Eastern Whip-poor-will	<ul style="list-style-type: none"> • Road/collision mortality. • Incompatible forest structure. • Possible declines in high quality prey 	<ul style="list-style-type: none"> • Identify high density areas and install highway signage. • Manage forests for interior gaps and edges. • Long-term monitoring of insect populations
Broad-winged Hawk	<ul style="list-style-type: none"> • Poor forest structure. • Residential development 	<ul style="list-style-type: none"> • Forest management for gaps
Kentucky Warbler	<ul style="list-style-type: none"> • Deer overherbivory. • Incompatible forest structure 	<ul style="list-style-type: none"> • Reduce deer population. • Manage forests for structural and spatial complexity
Worm-eating Warbler	<ul style="list-style-type: none"> • Deer overherbivory. • Incompatible forest structure. • Residential development 	<ul style="list-style-type: none"> • Reduce deer population. • Manage forests for structural and spatial complexity
Wood Thrush	<ul style="list-style-type: none"> • Deer overherbivory. • Incompatible forest structure. • Residential development 	<ul style="list-style-type: none"> • Reduce deer population. • Manage forests for structural and spatial complexity
Yellow-breasted Chat	<ul style="list-style-type: none"> • Forest maturation. • Herbicide use/veg mgmt in utility corridors 	<ul style="list-style-type: none"> • Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat
Summer Tanager	<ul style="list-style-type: none"> • Habitat loss and degradation 	<ul style="list-style-type: none"> • Manage forests for interior gaps and edges
Cerulean Warbler	<ul style="list-style-type: none"> • Poor forest structure 	<ul style="list-style-type: none"> • Manage forests to create suitable habitat as per CERW guidelines
Prairie Warbler	<ul style="list-style-type: none"> • Forest maturation. • Herbicide use/veg mgmt in utility corridors 	<ul style="list-style-type: none"> • Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat

Forests and Woodlands		
Common Name	Local Stress	Action
Blue-winged Warbler	<ul style="list-style-type: none"> • Insufficient habitat. • Residential development 	<ul style="list-style-type: none"> • Reduce clean farming practices. • Create early successional habitat
Gemmed Satyr	<ul style="list-style-type: none"> • Invasive species. • Loss of nectar resources 	<ul style="list-style-type: none"> • Control invasive Microstegium. • Enhance pollinator habitat
Northern Myotis	<ul style="list-style-type: none"> • Deforestation, agriculture, industry 	<ul style="list-style-type: none"> • Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Restore riparian corridors • Reduce nonpoint source pollution.
Mullein Foxglove	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Eastern False Rue-anemone	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Basil Mountain-mint	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Nodding Wakerobin	<ul style="list-style-type: none"> • Land development. • Small populations. • Hybridization 	<ul style="list-style-type: none"> • Pursue conservation easement or land purchase.
Timber Rattlesnake	<ul style="list-style-type: none"> • Persecution. • Collection. • Habitat destruction 	<ul style="list-style-type: none"> • Increased surveillance around susceptible den sites. • Use forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus, and rocky outcrops

Forests and Woodlands		
Common Name	Local Stress	Action
Eastern Box Turtle	<ul style="list-style-type: none"> • Collection. • Disease. • Road Mortality. • Habitat destruction. • Artificial increase in mesocarnivores 	<ul style="list-style-type: none"> • Reduce illegal collection. • Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease. • Improve road conditions to reduce mortality at identified hot spots. • Develop and distribute box turtle BMPs document for urban areas
Rock Outcrops, Cliffs and Talus		
Common Name	Local Stress	Action
Timber Rattlesnake	<ul style="list-style-type: none"> • Persecution. • Collection. • Habitat destruction 	<ul style="list-style-type: none"> • Increased surveillance around susceptible den sites. • Forest management to create canopy gaps. • Reduce canopy over known gestation and basking sites. • Develop basking structures to mitigate impacts to habitat. • Buffer boulder fields, talus, and rocky outcrops
Basil Mountain-mint	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.

Floodplain, Riparian, Ponds and Wetland Habitats		
Common Name	Local Stress	Action
Eastern Hellbender	<ul style="list-style-type: none"> • Persecution by anglers. • Sedimentation. • Field herpers. • Habitat manipulation. • Disease 	<ul style="list-style-type: none"> • Reduce "rock stacking" on hellbender streams. • Education to reduce negative impacts by anglers. • Maintain or restore forested riparian buffers to reduce sedimentation. • Fence livestock out of streams. • Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease
Mudpuppy	<ul style="list-style-type: none"> • Persecution by anglers. • Sedimentation. • Reduced water quality 	<ul style="list-style-type: none"> • Reduce pesticide use. • Fence livestock out of wetlands. • Educational materials to reduce negative impacts by anglers
American Woodcock	<ul style="list-style-type: none"> • Insufficient habitat. • Residential development 	<ul style="list-style-type: none"> • Reduce clean farming practices. • Create early successional habitat
Great Blue Heron	<ul style="list-style-type: none"> • Human disturbance at breeding sites. • Nest predation and competition for nest sites by bald eagle 	<ul style="list-style-type: none"> • Protect/buffer known rookeries. • Survey for new rookeries
Green Heron	<ul style="list-style-type: none"> • Human disturbance at breeding sites. • Degradation/loss of riparian habitats. • Poor water quality 	<ul style="list-style-type: none"> • Conserve/improve riparian habitats. • Improve water quality
Kentucky Warbler	<ul style="list-style-type: none"> • Deer overherbivory. • • Incompatible forest structure 	<ul style="list-style-type: none"> • Reduce deer population. • Manage forests for structural and spatial complexity
Belted Kingfisher	<ul style="list-style-type: none"> • Poor water quality. • Insufficient nest microhabitat 	<ul style="list-style-type: none"> • Identify important waterways and improve water quality

Floodplain, Riparian, Ponds and Wetland Habitats		
Common Name	Local Stress	Action
Louisiana Waterthrush	<ul style="list-style-type: none"> • Loss of riparian forests. • Stream degradation. • Acid deposition. • Residential development 	<ul style="list-style-type: none"> • Improve water quality. • Conserve riparian and upland stream valley forests. • Conservation easements
Rapids Clubtail	<ul style="list-style-type: none"> • Poor water quality of streams. • Loss of stream side vegetation 	<ul style="list-style-type: none"> • Improve municipal/household wastewater systems. • Maintain vegetation along streams
Northern Myotis	<ul style="list-style-type: none"> • Deforestation, agriculture, industry 	<ul style="list-style-type: none"> • Follow Forestry BMPs developed by White-Nose Syndrome • Response team. promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Banded Pennant	<ul style="list-style-type: none"> • Loss of emergent vegetation in and around ponds 	<ul style="list-style-type: none"> • Leave buffers and emergent vegetation around mature ponds.
Vesper Bluet	<ul style="list-style-type: none"> • Loss of emergent vegetation in and around ponds 	<ul style="list-style-type: none"> • Leave buffers and emergent vegetation around mature ponds.
Blue-faced Meadowhawk	<ul style="list-style-type: none"> • Loss of wetlands to development and siltation 	<ul style="list-style-type: none"> • Maintain wetlands
Midland Clubtail	<ul style="list-style-type: none"> • Poor water quality of streams. • Loss of stream side vegetation 	<ul style="list-style-type: none"> • Improve municipal/household wastewater systems. • Maintain vegetation along streams
Eastern False Rue-anemone	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Tennessee Pondweed	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.
Mullein Foxglove	<ul style="list-style-type: none"> • Unknown status 	<ul style="list-style-type: none"> • Field survey to determine species distribution and threats.

Floodplain, Riparian, Ponds and Wetland Habitats		
Common Name	Local Stress	Action
Eastern Spiny Softshell	<ul style="list-style-type: none"> • River channelization. • Sedimentation. • Recreation. • Artificial increase in mesocarnivores 	<ul style="list-style-type: none"> • Identify important nesting beaches. • Reduce human recreation on sandy beaches. • Trash clean-up to reduce mesopredators on nesting beaches. • Reduce boat wakes near nesting beaches to reduce erosion. stream bank stabilization and reduction of run-off to improve water quality. Protection of habitat upstream of known populations
Ouachita Map Turtle	<ul style="list-style-type: none"> • River channelization. Sedimentation. human recreation. artificial increase in mesocarnivores 	<ul style="list-style-type: none"> • Identify important nesting beaches. • Reduce human recreation on sandy beaches. • Trash clean-up to reduce mesopredators on nesting beaches. • Reduce boat wakes near nesting beaches to reduce erosion. • Stream bank stabilization and reduction of run-off to improve water quality. • Protection of habitat upstream of known populations
Eastern Box Turtle	<ul style="list-style-type: none"> • Collection. • Disease. Road Mortality. • Habitat destruction. • Artificial increase in mesocarnivores 	<ul style="list-style-type: none"> • Reduce illegal collection. • Educate land managers, biologists, and researchers about appropriate decontamination procedures to reduce the spread of disease. • Improve road conditions to reduce mortality at identified hot spots. • Develop and distribute box turtle BMPs document for urban areas

Aquatic Habitats		
Common Name	Local Stress	Action
Eastern Sand Darter	<ul style="list-style-type: none"> Increased sedimentation. River channelization. Point & nonpoint-source pollution 	<ul style="list-style-type: none"> Restore riparian area. Mitigate causes of sedimentation. BMPs by resource extraction companies
Southern Redbelly Dace	<ul style="list-style-type: none"> Increasing stream temperatures. Increased stream sedimentation 	<ul style="list-style-type: none"> Restore riparian areas. Mitigate causes of sedimentation. BMPs by resource extraction companies
Tippecanoe Darter	<ul style="list-style-type: none"> Increased sedimentation. River channelization. Point & nonpoint-source pollution 	<ul style="list-style-type: none"> Prevent and restore causes of sedimentation.
Ohio Lamprey	<ul style="list-style-type: none"> Increased sedimentation. Stream passage barriers 	<ul style="list-style-type: none"> Increase stream connectedness and riparian area restoration
Mountain Brook Lamprey	<ul style="list-style-type: none"> Increased sedimentation. Stream passage barriers 	<ul style="list-style-type: none"> Increase stream connectedness and riparian area restoration
Bigmouth Buffalo	<ul style="list-style-type: none"> River channelization. Disconnection of river and floodplain 	<ul style="list-style-type: none"> Riparian restoration
Black Buffalo	<ul style="list-style-type: none"> Hybridization with Smallmouth Buffalo. River channelization. Disconnection of river and floodplain 	<ul style="list-style-type: none"> Riparian restoration
American Brook Lamprey	<ul style="list-style-type: none"> Increased sedimentation. Stream passage barriers 	<ul style="list-style-type: none"> Riparian restoration
Bigeye Shiner	<ul style="list-style-type: none"> Increased sedimentation. Increased stream temperatures 	<ul style="list-style-type: none"> Riparian restoration. knotweed control. Resource extraction BMPs
Slenderhead Darter	<ul style="list-style-type: none"> Increased sedimentation. River channelization. Point & nonpoint-source pollution 	<ul style="list-style-type: none"> Riparian restoration

Aquatic Habitats		
Common Name	Local Stress	Action
Paddlefish	<ul style="list-style-type: none"> Increased sedimentation. River channelization. Point & nonpoint-source pollution 	<ul style="list-style-type: none"> Create and/or preserve island, shoal, and sandbar habitats
Snuffbox	<ul style="list-style-type: none"> Habitat loss. Sedimentation 	<ul style="list-style-type: none"> Erosion control
Long-solid	<ul style="list-style-type: none"> Hydroelectric dam. Water quality 	<ul style="list-style-type: none"> Sediment control and water quality improvement
Round Hickorynut	<ul style="list-style-type: none"> Sedimentation and in-stream work 	<ul style="list-style-type: none"> Erosion controls
Clubshell	<ul style="list-style-type: none"> Low connectivity within population. Sedimentation. 	<ul style="list-style-type: none"> Erosion controls. Potential stocking
Salamander Mussel	<ul style="list-style-type: none"> Sedimentation. Hydraulic changes. Water quality 	<ul style="list-style-type: none"> Sediment control. Water withdrawal conservation. Unconventional Oil & Gas BMP's
Anthropogenic Shrublands and Grasslands, Agricultural and Developed Habitats		
Common Name	Local Stress	Action
Chimney Swift	<ul style="list-style-type: none"> Chimney capping. Turnover of older structures 	<ul style="list-style-type: none"> Landowner outreach and education. Protect known significant migration roosts. Uncap chimneys. Install swift towers
American Woodcock	<ul style="list-style-type: none"> Insufficient habitat. Residential development 	<ul style="list-style-type: none"> Reduce clean farming practices. Create early successional habitat
Field Sparrow	<ul style="list-style-type: none"> Insufficient habitat 	<ul style="list-style-type: none"> Create early successional habitat
Eastern Meadowlark	<ul style="list-style-type: none"> Clean farming practices. Nest failure from incompatible haying practice 	<ul style="list-style-type: none"> Adjust timing of hay harvest. Conservation easements

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
Buffalo Run Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm
Burnsville Lake Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus, and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Small River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
Conway Run Lake Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool
Hughes River Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus, and Shale Barrens <ul style="list-style-type: none"> • Calcareous Cliffs and Talus • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Medium River, Low Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
Lewis Wetzel Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus, and Shale Barrens <ul style="list-style-type: none"> • Acidic Rock Outcrops, Cliffs, and Talus • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Warm
Ritchie Mines Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool
Sand Hill Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • Headwater Creek, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
Smoke Camp Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Developed 	<ul style="list-style-type: none"> • Headwater Creek, High Gradient, Cool
Stonewall Jackson Lake Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Small River, Moderate Gradient, Warm
Stumptown Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
The Jug Wildlife Management Area	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, High Gradient, Cool
Cedar Creek State Park	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small Stream Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Low Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
North Bend State Park	<ul style="list-style-type: none"> • Forest and Woodland <ul style="list-style-type: none"> • Anthropogenic Shrubland & Grassland • Dry-Mesic Oak Forests • Dry Oak (Pine) Forests • Mixed Mesophytic Forests • Rock Outcrops, Cliffs and Talus, and Shale Barrens <ul style="list-style-type: none"> • Calcareous Cliffs and Talus • Aquatic, Floodplain, and Riparian <ul style="list-style-type: none"> • Open Water • River Floodplains • Small River Riparian Habitats • Agricultural and Developed <ul style="list-style-type: none"> • Agriculture • Developed 	<ul style="list-style-type: none"> • Headwater Creek, Moderate Gradient, Warm • Headwater Creek, High Gradient, Cool • Small River, Low Gradient, Warm • Small River, Moderate Gradient, Warm

Appendix 4. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05030203000826	WVLKH-10-J_00	AddisRun	Fecal,
05030201002068	WVOMI-19_00	AllenRun	Fecal,
05030201001649	WVOMI-13_00	AllenRun	Fecal, Iron,
05030203002006	WVLK-75-Q_00	AlumFork	Bio,
05030203000828	WVLK-42_00	AnnamoriahRun	Bio,
05030201000129	WVOMI-40_00	ArnoldCreek	Fecal, Iron,
05030203001318	WVLKH-10-T-1_00	BackRun	Bio, Fecal,
05030201001866	WVOMI-23-A-2_00	BadgerRun	Iron,
05030203003104	WVLKH-10-CC_00	BearRun	Fecal,
05030203001208	WVLKH-9-AA-2_00	BearRun	Fecal,
05030203001325	WVLKH-10-AA_00	BeasonRun	Fecal,
05030201006760	WVOMI-46-L_00	BeechLick	Iron,
05030203001419	WVLKH-10-R-4-A_00	BeechRun	Bio, Fecal,
05030203001631	WVLKS-10-P_00	BenderRun	Bio,
05030203003317	WVLK-2-A_00	BerryRun	Fecal,
05030201001773	WVOMI-30-O-2_00	BigBattleRun	Bio, Fecal, Iron,
05030201001713	WVOMI-46-R_00	BigIsaacCreek	Fecal, Iron,
05030203001123	WVLKH-9-C_00	BigIslandRun	Fecal,
05030203001410	WVLKH-10-R-7_00	BigKnotRun	Bio, Fecal,
05030203001438	WVLKH-10-N_00	BigRun	Bio, Fecal,
05030203003182	WVLKH-9-HH_00	BigRun	Iron,
05030203001184	WVLKH-9-X-4_00	BigRun	Fecal,
05030201004112	WVOMI-23-B-1_00	BigRun	Iron,
05030201001820	WVOMI-29-A_00	BigRun	Fecal, Iron,
05030203002781	WVLKH-10-R-8_00	BlacksRun	Fecal,
05030201000740	WVOMI-43_00	BluestoneCreek	Fecal, Iron,
05030201001906	WVOMI-6_00	BogartRun	Fecal,
05030203001404	WVLKH-10-R_02	BondsCreek	Fecal, Iron,
05030203000748	WVLKH-10-R_01	BondsCreek	Fecal,
05030203000850	WVLKH-9-X_02	BoneCreek	Bio, Fecal, Iron,
05030203000849	WVLKH-9-X_01	BoneCreek	Fecal, Iron,
05030201001940	WVOMI-1_00	BroadRun	Iron,
05030203001463	WVLKH-4-N_00	BrushyFork	Bio, Fecal,
05030201000742	WVOMI-46-H_00	BrushyFork	Fecal, Iron,
05030203001347	WVLKH-10-GG_00	BuckRun	Fecal,
05030201001860	WVOMI-23-E-1_00	BuckRun	Bio, Fecal,
05030201000180	WVOMI-47_00	BuckeyeCreek	Fecal, Iron,
05030201000183	WVOMI-47-C_00	BuckeyeRun	Bio, Fecal, Iron,
05030201000745	WVOMI-47-E_00	BuffaloCalfFork	Fecal, Iron,
05030203001451	WVLKH-10-A_00	BuffaloRun	Bio, Fecal,
05030201004637	WVOMI-15_00	BuffaloRun	Fecal, Iron,
05030201001880	WVOMI-17_00	BuffaloRun(2ndupstream)	Iron,
05030203000862	WVLKH-10-Y_00	BunnellRun	Bio, Fecal,
05030203001349	WVLKH-10-KK_00	BurtonRun	Bio, Fecal,
05030203001697	WVLK-72-M_00	ButchersRun	Bio,
05030203000863	WVLKH-10-EE_01	CabinRun	Bio, Fecal, Iron,
05030203000865	WVLKH-10-EE_02	CabinRun	Bio, Fecal,

Reach Code	AUID	Common Name	Impairments
05030203001448	WVLKH-10-E_00	CabinRun	Fecal,
05030203001212	WVLKH-9-OO_00	CainRun	Fecal, Iron,
05030201005592	WVOMI-39_00	CampMistakeRun	Fecal, Iron,
05030203000347	WVLK-72_00	CedarCreek	Bio,
05030203002411	WVLK-31-Z-1_00	CharlesFork	Bio,
05030203000758	WVLKH-10-R-9_00	CharleysRun	Iron,
05030203000873	WVLKH-9-J-12_00	ChevauxdeFriseRun	Fecal,
05030201001684	WVOMI-40-F_00	ClaylickRun	Fecal, Iron,
05030203001216	WVLKH-9-DD.5_00	ClevengerHollow	Fecal,
05030201004180	WVOMI-23-C_00	CoallickRun	Fecal,
05030203002851	WVLKH-10-R-4_00	ComfortRun	Fecal,
05030203000881	WVLK-90_02	CopenRun	Fecal,
05030203000878	WVLK-90_01	CopenRun	Bio, Fecal,
05030203001369	WVLKH-10-W_00	CunninghamRun	Bio, Fecal,
05030203001338	WVLKH-10-FF_00	DotsonRun	Bio, Fecal, Iron,
05030203002912	WVLKH-4-Q_00	DouglasRun	Fecal,
05030203000888	WVLK-82_01	DuckCreek	Bio,
05030203000888	WVLK-82_02	DuckCreek	Bio, Iron,
05030203001740	WVLK-88_01	DuskcampRun	Fecal, Iron,
05030203001741	WVLK-88_02	DuskcampRun	Bio, Fecal, Iron,
05030203001135	WVLKH-9-H_00	DutchmanRun	Bio, Fecal,
05030201001766	WVOMI-30-H-6_00	EastRun	Iron,
05030201000236	WVOMI-23-B_00	ElkFork	Fecal, Iron,
05030201001795	WVOMI-30-I_00	ElklickRun	Iron,
05030203000893	WVLK-25-B-10_00	EnochFork	Bio,
05030203000513	WVLK-75-N_00	FinkCreek	Bio,
05030201001632	WVOMI-2_00	FishpotRun	Iron,
05030203001121	WVLKH-8_00	FlintRun	Bio, Fecal,
05030201000196	WVOMI-30-H_00	FlintRun	Fecal, Iron,
05030203000067	WVLK-25-B-9_00	FullsFork	Bio,
05030201001690	WVOMI-46-0.8A_00	GeorgescampRun	Iron,
05030203001070	WVLK-2-D_00	GillespieRun	Fecal,
05030203000903	WVLKH-10-C_00	GillespieRun	Fecal,
05030203001360	WVLKH-10-HH_00	GnatRun	Bio,
05030203002885	WVLKH-4_02.3	GooseCreek	Bio,
05030203000765	WVLKH-4_02.1	GooseCreek	Bio,
05030203000760	WVLKH-4_01	GooseCreek	Fecal,
05030203001118	WVLKH-3_00	GooseneckRun	Bio,
05030203001927	WVLK-86-E-8_00	GoosepenRun	Bio,
05030201000758	WVOMI-24_00	GorrellRun	Bio, Fecal, Iron,
05030203000623	WVLKH-9-Q_00	GrassRun	Fecal,
05030201001729	WVOMI-47-G_00	GreenbrierCreek	Iron,
05030203002766	WVLKH-10-JJ_00	HaddoxRun	Bio,
05030203001214	WVLKH-9-GG.5_00	HoltRun	Fecal, Iron,
05030203000586	WVLKH_00	HughesRiver	Fecal, Iron,
05030203001387	WVLKH-10-R-1_02	HushersRun	Fecal, Iron,
05030203001386	WVLKH-10-R-1_01	HushersRun	Bio, Fecal, Iron,
05030203000688	WVLKH-9-J_02	IndianCreek	Fecal, Iron,

Reach Code	AUID	Common Name	Impairments
05030203000685	WVLKH-9-J_01	IndianCreek	Fecal, Iron,
05030201000227	WVOMI-29_00	IndianCreek	Bio, Fecal,
05030203000471	WVLK-86-E_00	IndianFork	Bio,
05030201000763	WVOMI-46-J_00	IndianFork	Fecal, Iron,
05030203002020	WVLK-75-N-7_00	IsaacsFork	Bio,
05030201001759	WVOMI-30-H-3_00	IsraelFork	Iron,
05030201000768	WVOMI-33_00	JeffersonRun	Iron,
05030203001241	WVLKH-9-T_00	JesseCainRun	Fecal,
05030203002085	WVLK-68_00	JobRun	Bio,
05030201001742	WVOMI-45_00	JockeycampRun	Iron,
05030203002527	WVLK-25-R-2_00	JohnsonRun	Bio,
05030201001924	WVOMI-4-I_00	JosephsFork	Iron,
05030203001249	WVLKH-9-P_00	LambRun	Fecal, Iron,
05030203001132	WVLKH-9-F_00	LaurelRun	Fecal,
05030203000941	WVLKW-15-F_00	LaurelRun	Bio,
05030201006214	WVOMI-46-Q_00	LaurelRun	Iron,
05030203001462	WVLKH-4-O_00	LayfieldsRun	Bio, Fecal,
05030203002166	WVLK-40_01	LeadingCreek	Bio,
05030203002971	WVLKH-10-EE-1_00	LeasonRun	Bio, Fecal,
05030203000612	WVLKH-9-M_01	LeatherbarkCreek	Fecal, Iron,
05030203000612	WVLKH-9-M_02	LeatherbarkCreek	Fecal, Iron,
05030201000136	WVOMI-40-J_00	LeftFork/ArnoldCreek	Fecal, Iron,
05030203003783	WVLKH-9-X-6_00	LeftFork/BoneCreek	Fecal, Iron,
05030203002491	WVLK-25-S_00	LeftFork/ReedyCreek	Bio,
05030203000677	WVLKH-9-W-4_00	LeftFork/SlabCreek	Fecal,
05030203001171	WVLKH-9-R-9_00	LeftFork/SpruceCreek	Bio, Fecal,
05030203000308	WVLKS-10_00	LeftFork/SteerCreek	Bio,
05030203002305	WVLKW-31_00	LeftFork/WestFork/LittleKanawhaRiver	Bio,
05030203001474	WVLKH-4-A_00	LickRun	Fecal,
05030203001139	WVLKH-9-J.5_00	LickRun	Fecal, Iron,
05030201001691	WVOMI-46-B_00	LickRun	Fecal, Iron,
05030201001772	WVOMI-30-O-1_00	LittleBattleRun	Iron,
05030201001775	WVOMI-30-O-2-A_00	LittleBattleRun	Iron,
05030201001754	WVOMI-30-H-1_00	LittleFlintRun	Fecal, Iron,
05030201001706	WVOMI-46-J-1_00	LittleIndianFork	Iron,
05030203000007	WVLK_01	LittleKanawhaRiver	Fecal, Iron,
05030201000769	WVOMI-21-A_00	LittleSanchoCreek	Fecal, Iron,
05030201000772	WVOMI-46-E-1_00	LittleTomsFork	Iron,
05030203002755	WVLKH-10-MM_00	LizziesRoostRun	Fecal,
05030203001296	WVLKH-9-A_00	LocustRun	Fecal,
05030203001243	WVLKH-9-S_00	LongRun	Bio, Fecal,
05030203003312	WVLKH-4-I_00	LongRun	Fecal,
05030201000777	WVOMI-40-B_00	LongRun	Fecal, Iron,
05030203001117	WVLKH-2_00	LydaRun	Bio, Fecal,
05030203001978	WVLK-85_01	LynchRun	Bio, Fecal, Iron, Manganese,
05030203001978	WVLK-85_02	LynchRun	Bio, Fecal, Iron,
05030203001331	WVLKH-10-DD_00	LynncampRun	Bio, Fecal,
05030203000969	WVLKH-9-G_00	MacfarlanCreek	Fecal, Iron,

Reach Code	AUID	Common Name	Impairments
05030203001350	WVLKH-10-LL_00	MarshRun	Bio, Fecal,
05030201000205	WVOMI-30_00	McElroyCreek	Bio, Fecal, Iron,
05030203001401	WVLKH-10-R-6_00	McGregorRun	Fecal,
05030201000051	WVOMI-4_01	McKimCreek	Bio, Fecal, Iron,
05030201000065	WVOMI-4_02	McKimCreek	Fecal, Iron,
05030201000170	WVOMI-46_00	MeathouseFork	Bio, Fecal, Iron,
05030201001840	WVOMI-23-B-3-A_00	MiddleFork/MudlickRun	Iron,
05030203001196	WVLKH-9-AA_00	MiddleFork/SouthFork/HughesRiver	Fecal, Iron,
05030201000088	WVOMI_01	MiddleIslandCreek	Fecal, Iron,
05030201000139	WVOMI_02	MiddleIslandCreek	Bio, Fecal, Iron,
05030201001685	WVOMI-40-H_00	MiddleRun	Iron,
05030203001082	WVLK-4_00	MillRun	Fecal,
05030201001736	WVOMI-47-B_00	MorgansRun	Iron,
05030203000788	WVLK-10-(L1)_00	MountwoodParkLake	Sedimentation,
05030201000782	WVOMI-26_00	MuddyCreek	Iron,
05030201001841	WVOMI-23-B-3_00	MudlickRun	Fecal, Iron,
05030203000974	WVLKH-4-H_00	MyersFork	Fecal,
05030201001768	WVOMI-30-H-4_00	NedsRun	Iron,
05030203002740	WVLKH-10_05	NorthFork/HughesRiver	Bio, Fecal, Iron,
05030203000699	WVLKH-10_01	NorthFork/HughesRiver	Fecal,
05030203003132	WVLKH-10_04	NorthFork/HughesRiver	Fecal, Iron,
05030203000723	WVLKH-10_03	NorthFork/HughesRiver	Iron,
05030203000975	WVLKH-4-L_00	NutterFork	Bio, Fecal,
05030201000784	WVOMI-41_00	NutterFork	Iron,
05030203001470	WVLKH-4-G_00	OilSpringRun	Fecal, Iron,
05030203000979	WVLKH-9-Y_00	OtterslideCreek	Fecal,
05030203001251	WVLKH-9-O_00	OwlRun	Fecal,
05030203001211	WVLKH-9-MM_00	PainterRun	Fecal,
05030201001910	WVOMI-4-C_00	PantherRun	Iron,
05030201006534	WVOMI-23-G_01	PeachFork	Bio, Fecal,
05030201006538	WVOMI-23-G_02	PeachFork	Fecal,
05030201001783	WVOMI-30-P_00	PikeFork	Fecal, Iron,
05030201000231	WVOMI-23_00	PointPleasantCreek	Bio, Fecal,
05030203001357	WVLKH-10-II_01	PoplarlickRun	Bio, Fecal,
05030203001358	WVLKH-10-II_02	PoplarlickRun	Fecal,
05030203001217	WVLKH-9-CC_00	PovertyHollow	Fecal,
05030201001752	WVOMI-30-C_00	PrattRun	Iron,
05030201001670	WVOMI-34_00	PurgatoryRun	Iron,
05030201000264	WVOMI-23-A_00	PursleyCreek	Bio, Fecal, Iron,
05030201006171	WVOMI-46-G_00	RedlickRun	Iron,
05030203000074	WVLK-25_00	ReedyCreek	Bio, Iron,
05030201000808	WVOMI-30-K_00	RigginsRun	Iron,
05030201000810	WVOMI-40-I_00	RightFork/ArnoldCreek	Bio, Fecal,
05030203001187	WVLKH-9-X-5_00	RightFork/BoneCreek	Fecal, Iron,
05030203001743	WVLK-88-A_00	RightFork/DuskcampRun	Bio, Iron,
05030203002484	WVLK-25-Q_00	RightFork/ReedyCreek	Bio,
05030203001229	WVLKH-9-W-5_00	RightFork/SlabCreek	Fecal,
05030203001163	WVLKH-9-R-8_00	RightFork/SpruceCreek	Fecal,

Reach Code	AUID	Common Name	Impairments
05030203006080	WVLKS-9_00	RightFork/SteerCreek	Bio,
05030201000209	WVOMI-30-O_00	RobinsonFork	Fecal, Iron,
05030203004140	WVLKH-5_00	RockRun	Fecal, Iron,
05030201001918	WVOMI-4-D_00	RockRun	Iron,
05030203001323	WVLKH-10-X_00	RockcampRun	Bio,
05030203002048	WVLK-75-K-7_00	RushRun	Bio,
05030203001309	WVLKH-10-K_00	RushRun	Bio, Fecal,
05030203001552	WVLKS-4_00	RushRun	Bio,
05030203000387	WVLK-95_00	SaltlickCreek	Iron,
05030203000391	WVLK-95-(L1)_00	SaltlickPond9	Sedimentation,
05030201000099	WVOMI-21_01	SanchoCreek	Bio,
05030203000486	WVLK-86_00	SandFork	Bio, Iron,
05030203000522	WVLK-75-N-5_00	SandFork	Bio,
05030201001753	WVOMI-30-E_00	SandyRun	Iron,
05030203002241	WVLKW-15-I-9_00	SangRun	Bio,
05030203000087	WVLK-25-Q-1_00	SeamanFork	Bio,
05030203001473	WVLKH-4-B_00	SecondBigRun	Fecal,
05030201001936	WVOMI-4-A_00	ShawneeRun	Iron,
05030203001442	WVLKH-10-H_00	SheepRun	Fecal,
05030201001896	WVOMI-14_00	SheetsRun	Iron,
05030203001468	WVLKH-4-J_00	ShortRun	Fecal,
05030201001675	WVOMI-40-A_00	ShortRun	Iron,
05030201004570	WVOMI-18_00	ShriversRun	Fecal,
05030203001475	WVLKH-1_00	SilverRun	Fecal, Iron,
05030203001441	WVLKH-10-L_00	SilverRun	Fecal,
05030203000550	WVLK-74_00	SinkingCreek	Bio,
05030201001780	WVOMI-30-O-5_00	SkeltonRun	Iron,
05030203000672	WVLKH-9-W_00	SlabCreek	Fecal,
05030203003495	WVLKH-10-I.5_00	SlaughterhouseRun	Fecal,
05030203003790	WVLKH-9-V_00	SmithRun	Fecal,
05030201001720	WVOMI-46-I_00	SnakeRun	Fecal,
05030203000667	WVLKH-9_03_r	SouthFork/HughesRiver	Fecal, Iron,
05030203000641	WVLKH-9_02_r	SouthFork/HughesRiver	Bio, Fecal, Iron,
05030203000607	WVLKH-9_01_r	SouthFork/HughesRiver	Fecal, Iron,
05030201001640	WVOMI-9-E_00	SouthFork/SugarCreek	Iron,
05030203000113	WVLK-31_00	SpringCreek	Bio, Iron,
05030203001363	WVLKH-10-BB_00	SpringRun	Bio, Fecal,
05030203000633	WVLKH-9-R_00	SpruceCreek	Bio, Fecal, Iron,
05030201004752	WVOMI-29-H_00	StackpoleRun	Iron,
05030203001013	WVLKS-10-E_00	SteerRun	Bio,
05030203001016	WVLK-79_00	StewartCreek	Bio,
05030203001025	WVLKH-10-V_00	StewartRun	Fecal,
05030203001027	WVLK-39_00	StraightCreek	Bio,
05030203003501	WVLKH-9-AA-4_00	StraightFork	Fecal,
05030201005247	WVOMI-9_00	SugarCreek	Bio, Fecal, Iron,
05030201004975	WVOMI-30-P-1_00	SycamoreFork	Fecal, Iron,
05030201000215	WVOMI-30-N_00	TalkingtonFork	Fecal, Iron,
05030203000565	WVLK-66_00	TannerCreek	Bio,

Reach Code	AUID	Common Name	Impairments
05030203001033	WVLKS-9-D_00	TannerFork	Bio,
05030203001036	WVLK-31-X_00	TannerRun	Bio, Fecal,
05030201001845	WVOMI-23-D_00	TenmileRun	Iron,
05030203001899	WVLK-94-F_00	ThreelickRun	Bio,
05030201000152	WVOMI-46-E_00	TomsFork	Iron,
05030203002542	WVLK-25-S-11_00	TuckerRun	Bio,
05030203001227	WVLKH-9-Z_00	TurtleRun	Fecal,
05030203001412	WVLKH-10-R-5.7_00	UNT/BondsCreekRM11.47	Fecal,
05030201005847	WVOMI-47-C-2.6_00	UNT/BuckeyeRunRM3.35	Fecal, Iron,
05030201001894	WVOMI-15-0.3A_00	UNT/BufaloRunRM0.99	Fecal, Iron,
05030201001750	WVOMI-39-C_00	UNT/CampMistakeRunRM0.96	Iron,
05030203001340	WVLKH-10-FF-9_00	UNT/DotsonRunRM2.17	Fecal,
05030201001758	WVOMI-30-H-1-D_00	UNT/LittleFlintRunRM1.96	Iron,
05030203004910	WVLK-85-C_00	UNT/LynchRunRM0.91	Iron,
05030201001687	WVOMI-41.5_00	UNT/MiddleIslandCreekRM67.32	Fecal, Iron,
05030203001446	WVLKH-10-F.3_00	UNT/NorthForkRM7.87/HughesRiver	Fecal,
05030201003702	WVOMI-23-G-0.5_00	UNT/PeachForkRM0.42	Fecal, Iron,
05030203003341	WVLKH-9-PP_00	UNT/SouthForkRM55.73/HughesRiver	Fecal, Iron,
05030201004769	WVOMI-15-0.3A-5_00	UNT/UNTRM1.63/BufaloRunRM0.99	Fecal,
05030203001202	WVLKH-9-AA-6_00	UpperRun	Bio, Fecal,
05030203000790	WVLK-10_00	WalkerCreek	Bio,
05030201004589	WVOMI-29-E_00	WalnutFork	Fecal, Iron,
05030201001639	WVOMI-9-C_00	WalnutRun	Iron,
05030201001698	WVOMI-46-E-1-A_00	WebleyFork	Iron,
05030203000205	WVLKW_00	WestFork/LittleKanawhaRiver	Bio,
05030201001668	WVOMI-31_00	WheelerRun	Iron,
05030203001415	WVLKH-10-R-5_00	WhiskeyRun	Bio, Fecal,
05030203001219	WVLKH-9-BB_00	WhiteOakCreek	Fecal, Iron,
05030203001653	WVLKS-10-D_00	WhiteOakRun	Bio,
05030203001440	WVLKH-10-M_00	WildcatRun	Fecal,
05030201001683	WVOMI-40-E_00	WilhelmRun	Bio, Fecal, Iron,
05030201001857	WVOMI-23-E_00	WillowFork	Fecal, Iron,
05030201001939	WVOMI-3_00	WillowIslandCreek	Iron,
05030201001635	WVOMI-5_00	WolfRun	Iron,
05030203001239	WVLKH-9-W-1_00	WolfpenRun	Fecal,
05030201001846	WVOMI-23-D-1_00	WolfpenRun	Iron,
05030201001746	WVOMI-41-B_00	WolfpenRun	Iron,

Appendix 5. Partners and Assistance Provided

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

Partner	Role/Assistance Provided
<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>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 Planning Commissions</p>	<ul style="list-style-type: none"> • Planning to manage floodplains and guide new development

Partner	Role/Assistance Provided
<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) <p>https://www.treefarmssystem.org/</p> <ul style="list-style-type: none"> • Sustainable Forestry Initiative (SFI) <p>https://www.forests.org/</p> <p>https://www.wvfa.org/sfi/</p> <ul style="list-style-type: none"> • Forest Stewardship Council (FSC) <p>https://fsc.org/en</p>	<ul style="list-style-type: none"> • Resources, assistance and certification for sustainable forest management on public and private lands
<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

Partner	Role/Assistance Provided
<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.
<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 impacts. <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</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 land conservation organizations with forest and land protection and restoration • Assist landowners with protection and improved management of large forest tracts through conservation easements and forest carbon projects • Manages a network of nature preserves and conservation easements for conservation and recreation

Partner	Role/Assistance Provided
<p>Trout Unlimited</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
<p>USDA Farm Service Agency</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:</p> <p>https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/</p> <ul style="list-style-type: none"> • Environmental Quality Incentive Program (EQIP) • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP) • Climate Smart Agriculture and Forestry 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.

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>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.

Partner	Role/Assistance Provided
<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
<p>WV Department of Health and Human Resources (WVDHHR)</p> <ul style="list-style-type: none"> • On-Site Sewage Program https://www.wvdhhr.org/phs/sewage/index.asp 	<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.

Partner	Role/Assistance Provided
<p>WV Division of Forestry (WVD OF)</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
<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.

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 Little Kanawha, Upper Ohio and West Fork Conservation Districts:

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

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

National Wild Turkey Foundation- Landowner's Toolbox

https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Responsible_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

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>

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>

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>

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>