Action Plan for the Northern Panhandle Conservation Focus Area

June, 2023

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List of Acronyms Used

ACEP- Agricultural Conservation Easement Program
AMJV- Appalachian Mountain Joint Venture
BMPs- Best Management Practices
B-Rank- Biodiversity Rank
CFA- Conservation Focus Area
CCV- Cave Conservancy of the Virginias
CCVI- Climate Change Vulnerability Index
CERW- Cerulean Winged Warbler
CREP- Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CSP- Conservation Stewardship Program
EQIP- Environmental Quality Improvement Program
ESH- Early Successional Habitat
FSA- Farm Service Agency
G Rank- Global Rank
GWWA- Golden-winged Warbler
HUC- Hydrologic Unit Code
NRCS- Natural Resources Conservation Service
NPCD- Northern Panhandle Conservation District
NWTF- National Wild Turkey Foundation
ORSANCO- Ohio River Valley Sanitation Commission
RGS- Roughed Grouse Society
SGCN- Species of Greatest Conservation Need
S Rank- State Rank
SWAP- State Wildlife Action Plan
TNC- The Nature Conservancy
TU- Trout Unlimited
USACE- Unites States Army Corps of Engineers
USDA- United States Department of Agriculture
USFWS- United States Fish and Wildlife Service
WMA- Wildlife Management Area
WVACS- West Virginia Association of Cave Studies
WVCA- West Virginia Conservation Agency
WVCC- West Virginia Cave Conservancy
WVDEP- West Virginia Department of Environmental Protection
WVDHHR- Department of Health and Human Resources
WVDNR- West Virginia Division of Natural Resources
WVDOA- West Virginia Department of Agriculture
WVDOF- West Virginia Division of Forestry
WVDOH- West Virginia Division of Highways
WVU- West Virginia University

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species, and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups, cave interest groups and other non-profit conservation organizations working in the area to develop this Action Plan for the Northern Panhandle 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 39 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the Action Plan lists the priority species, stresses and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. A plan for implementation for each major habitat type lists partners and programs available to assist with each of the actions and metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The Action Plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA, and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience and outlines next steps in plan implementation.

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

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

Introduction to the State Wildlife Action Plan & Conservation Focus Areas

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

Species of Greatest Conservation Need, Habitats and Stresses

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

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

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

Conservation Actions

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

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

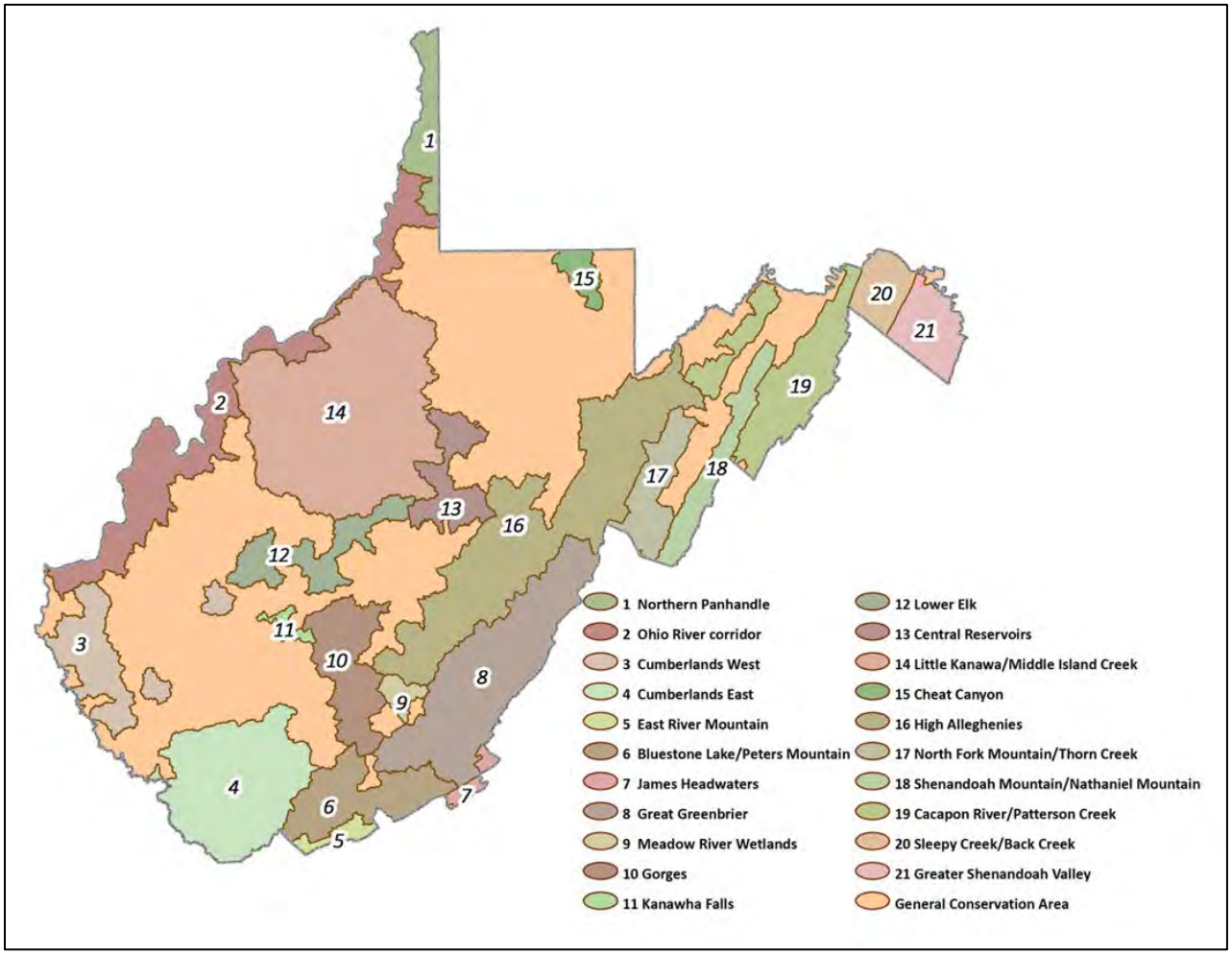
Conservation actions vary according to the species and the specific stresses; actions can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve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

Conservation Focus Areas and Action Plans

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

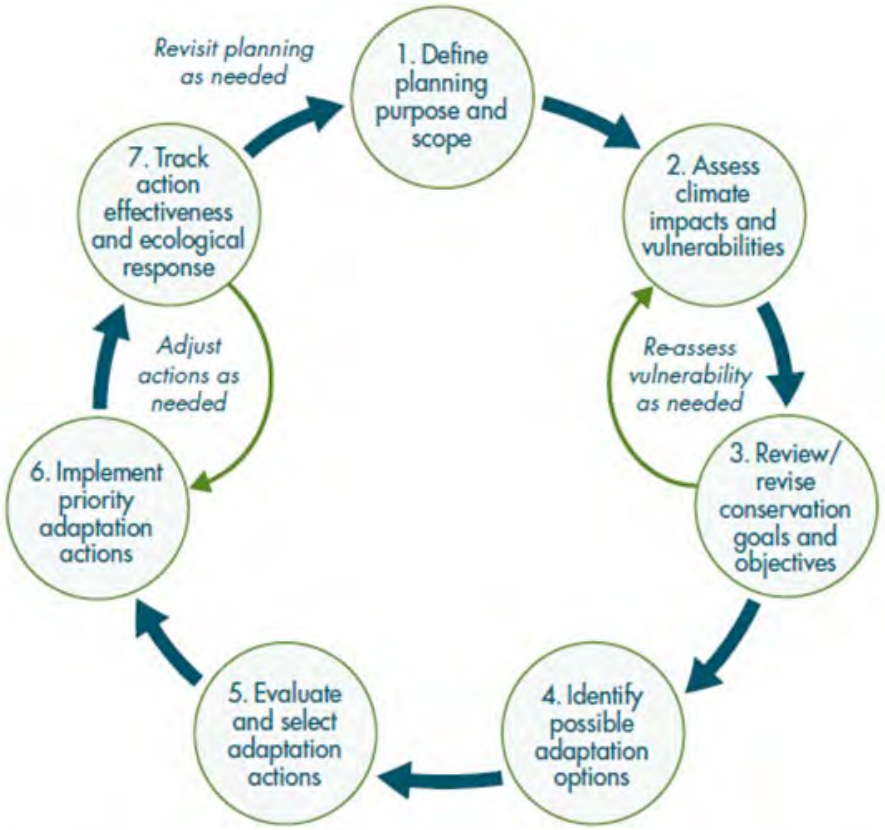
others. The SWAP suggests that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change and ecological connectivity within and between landscapes. Rather than a species-specific approach,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

Northern Panhandle Conservation Focus Area

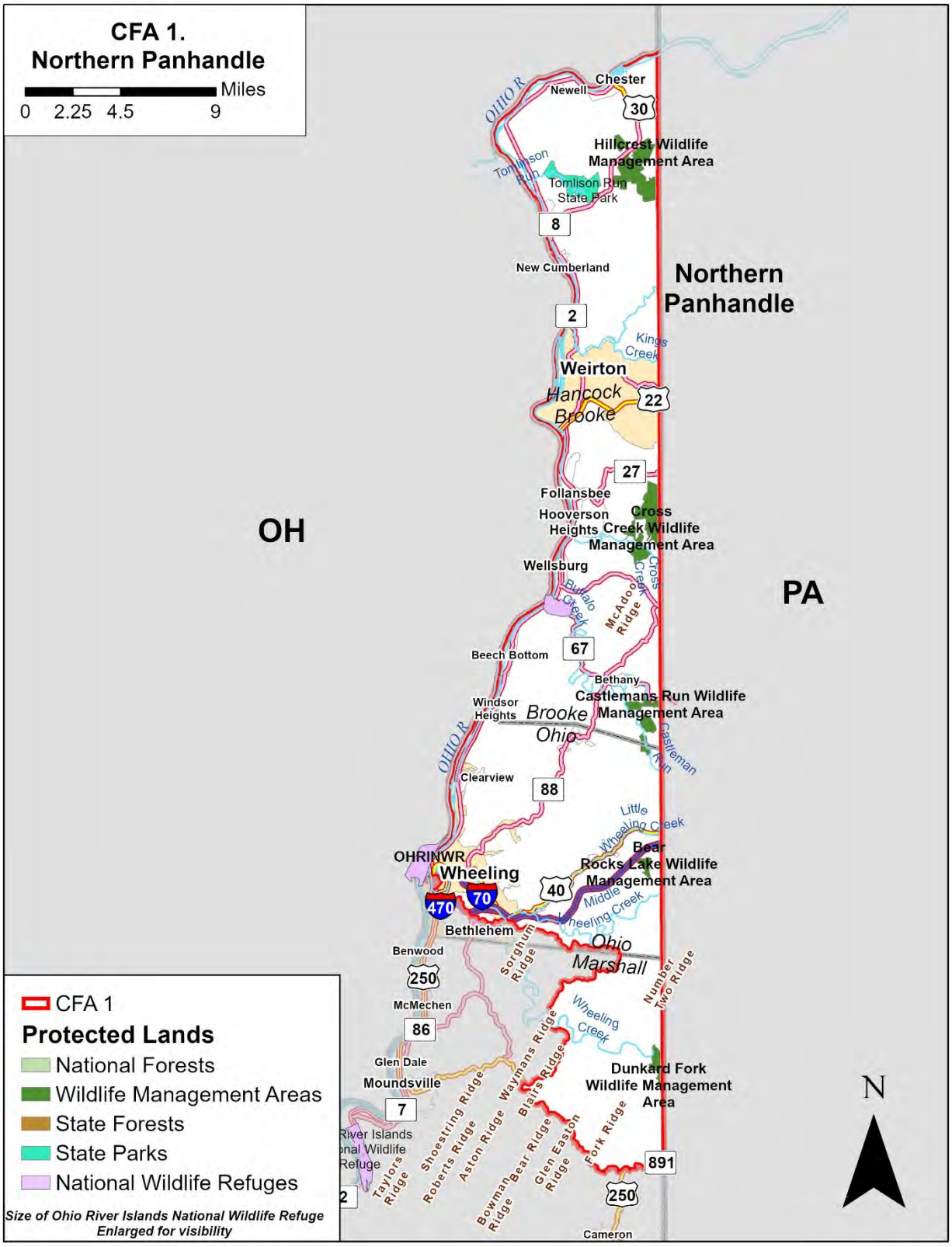
Overview

In the Western Allegheny Plateau Ecoregion, the Northern Panhandle Conservation Focus Area covers most of West Virginia's Northern Panhandle from Hancock County southward into Marshall County, including the northern reaches of the Ohio River. The Ohio River floodplain, at 650 to 700 feet in elevation, meets bluffs and rolling hills that rise to 1300 feet which are dissected by numerous tributaries that cut through sandstone, coal and small areas of limestone. All of the streams in this CFA drain into the Ohio River, and the larger tributaries originate in Pennsylvania. The original matrix of deciduous forest has been significantly fragmented into smaller forest patches mostly by:

- Ridgetop agricultural areas
- Reclaimed surface mines
- Suburban housing
- Urban areas

The floodplain and adjacent areas along the Ohio River typically have intense residential, urban and industrial development, including two large cities: Wheeling and Weirton. Horizontal gas drilling and associated infrastructure are increasing. The mainstem of the Ohio River is completely controlled by locks and dams for navigation.

Map 2. Overview



Habitats

The Northern Panhandle CFA includes a variety of terrestrial, aquatic and subterranean habitat types.

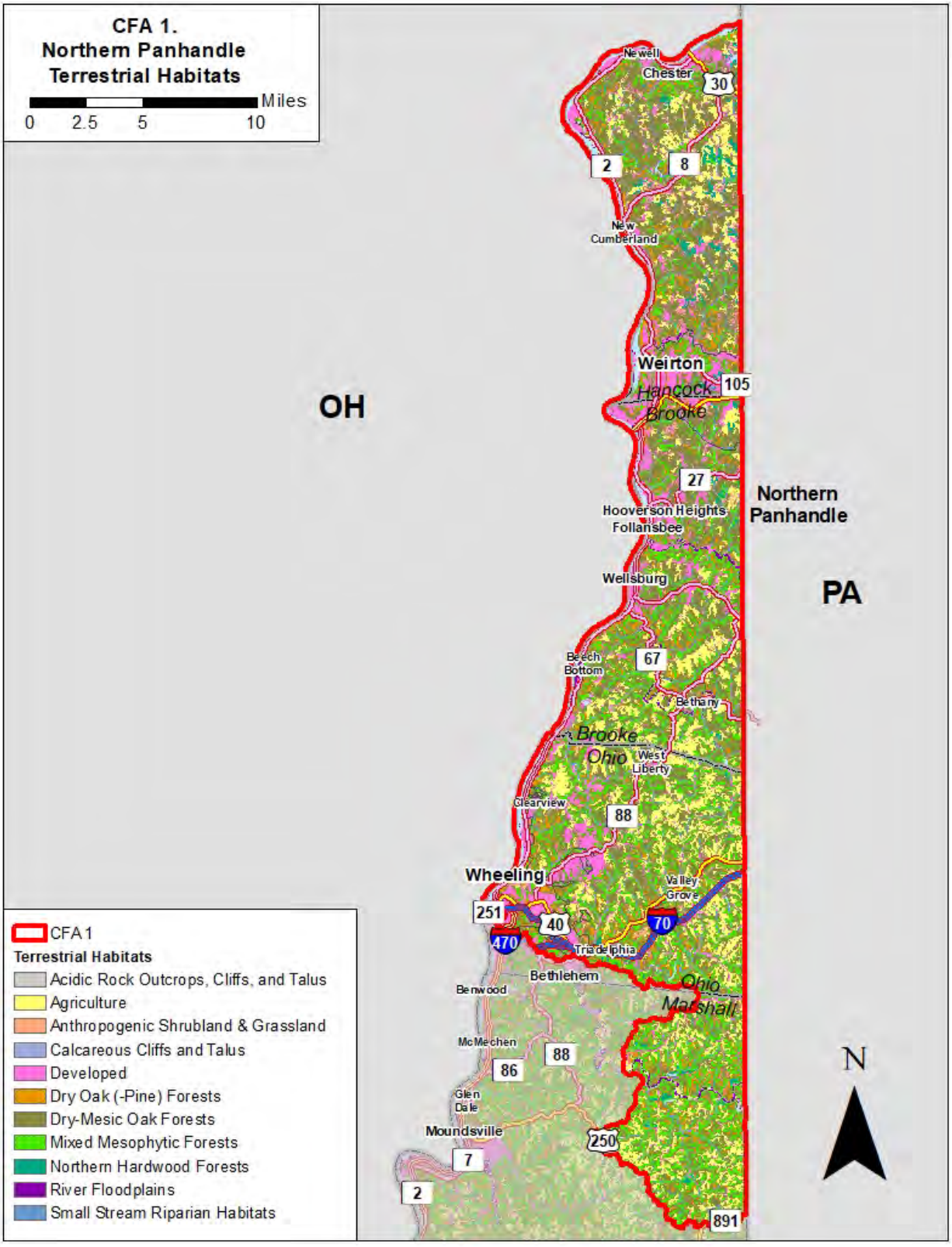
Terrestrial Habitats

Eleven of the habitat types described in the SWAP are present in this CFA. Dry-Mesic Oak Forests are the most abundant of the terrestrial habitats present in the CFA, covering 35% of the total area within the CFA, but comprises less than 2% of the total amount of habitat of that type in West Virginia. Developed, agricultural and anthropogenic shrubland and grassland habitats comprise over 30% of the CFA. Terrestrial habitats are described in Chapter 3 of the 2015 SWAP.

Table 1. Terrestrial Habitat Summary

Habitat Type	Acres in CFA	Percent of CFA Area	Percent of WV Total for Type
Acidic Rock Outcrops, Cliffs and Talus	145	0.07%	0.16%
Agriculture	29,995	14.27%	2.09%
Anthropogenic Shrubland & Grassland	4,263	2.03%	2.68%
Calcareous Cliffs and Talus	48	0.02%	0.52%
Developed	32,288	15.36%	2.83%
Dry Calcareous Forests, Woodlands and Glades	0	0.00%	0.00%
Dry Oak (-Pine) Forests	10,130	4.82%	0.41%
Dry-Mesic Oak Forests	75,652	35.99%	1.52%
Heath-Grass Barrens	0	0.00%	0.00%
High Allegheny Wetlands	0	0.00%	0.00%
Mixed Mesophytic Forests	38,316	18.23%	1.30%
Montane Red Oak Forests	0	0.00%	0.00%
Northern Hardwood Forests	2,952	1.40%	0.30%
Pine-Oak Rocky Woodlands	0	0.00%	0.00%
Red Spruce Forests	0	0.00%	0.00%
River Floodplains	1,958	0.93%	1.63%
Shale Barrens	0	0.00%	0.00%
Sinkhole and Depression Ponds	0	0.00%	0.00%
Small Stream Riparian Habitats	5,842	2.78%	1.18%
Unresolved	8,634	4.11%	7.40%
Totals	210,223	100.00%	

Map 3. Terrestrial Habitats



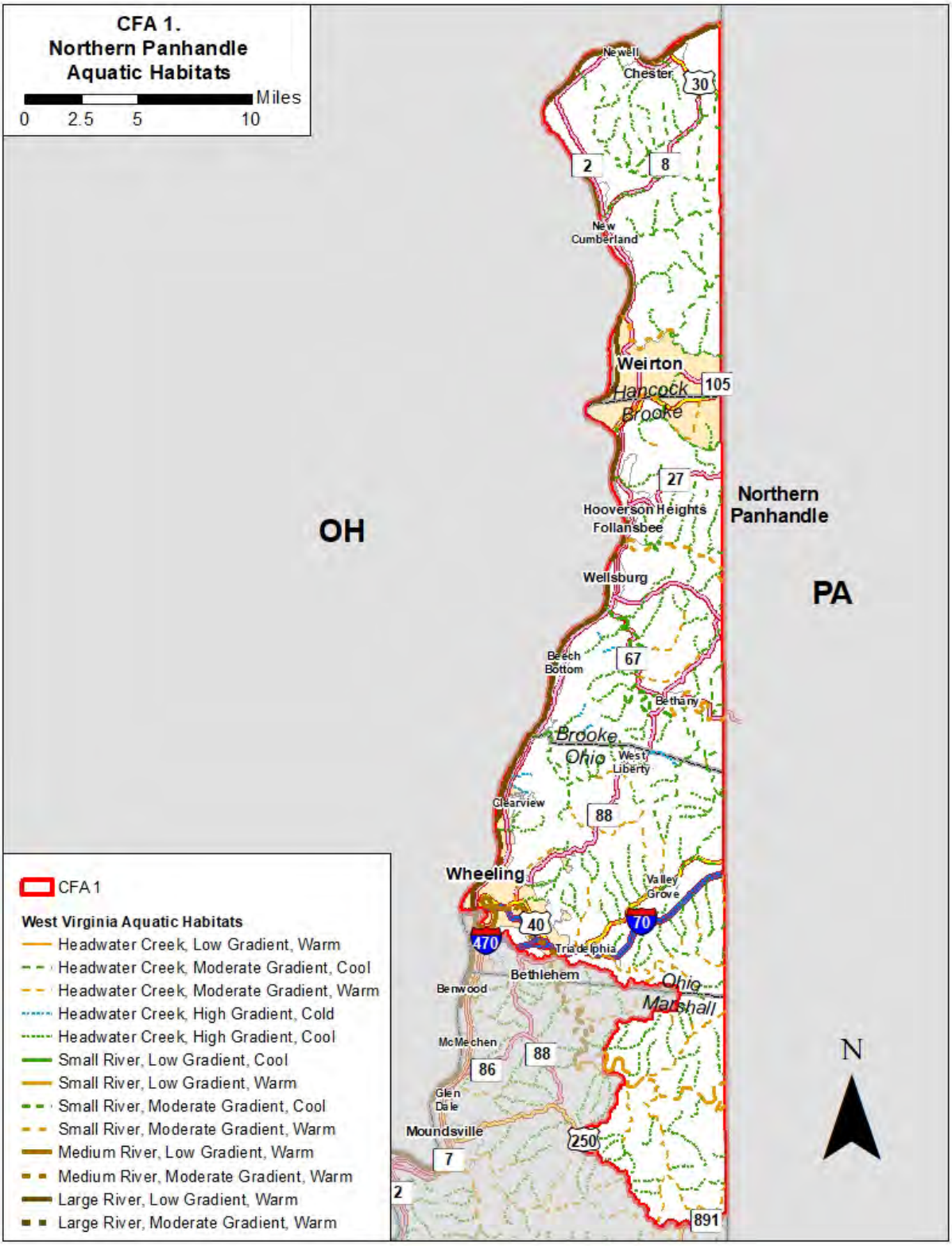
Aquatic Habitats

Thirteen of the aquatic habitat types described in the SWAP are present within the Northern Panhandle CFA. The most abundant of which are cool, high gradient headwater creek habitats, which encompass 190 miles of waterway within the CFA and comprise 40% of aquatic habitat types present. Aquatic habitats are described in Chapter 3 of the 2015 SWAP.

Table 2. Aquatic Habitat Summary

Habitat Type	Miles in CFA	Percent of CFA Miles	Percent of WV Total for Type
Headwater Creek, Low Gradient, Warm	2	0.52%	0.44%
Headwater Creek, Moderate Gradient, Cool	93	19.87%	4.24%
Headwater Creek, Moderate Gradient, Warm	69	14.66%	1.76%
Headwater Creek, High Gradient, Cold	6	1.30%	0.21%
Headwater Creek, High Gradient, Cool	190	40.61%	3.03%
Small River, Low Gradient, Cool	1	0.19%	2.40%
Small River, Low Gradient, Warm	9	1.96%	2.00%
Small River, Moderate Gradient, Cool	14	2.94%	2.95%
Small River, Moderate Gradient, Warm	25	5.43%	4.69%
Medium River, Low Gradient, Warm	4	0.84%	0.82%
Medium River, Moderate Gradient, Warm	4	0.83%	1.12%
Large River, Low Gradient, Warm	50	10.59%	8.53%
Large River, Moderate Gradient, Warm	1	0.26%	1.13%
Totals	468	100.00%	

Map 4. Aquatic Habitats



Species of Greatest Conservation Need

Table 3 lists the number of SGCN in each taxa listed in the SWAP for the Northern Panhandle CFA.

Table 3. Species Summary by Taxa

Taxa	# SGCN
Amphibian	2
Birds	29
Butterflies and Moths	2
Cave Invertebrates	1
Dragonflies and Damselflies	4
Fish	27
Mammals	4
Mussels	32
Plants	13
Reptiles	4
Snails	7
Totals	**125**

As elsewhere in West Virginia, the Ohio River and its tributaries (especially Wheeling and Buffalo creeks) provide significant aquatic habitat for:

- 32 known SGCN mussel species (with additional species regularly being re-discovered)
- 27 SGCN fish
- Eastern Hellbender

Forested areas provide important summering habitat for:

- The federally listed Indiana Bat
- Northern Long-eared Bat which has not declined here from White-Nose Syndrome (WNS) as much as it has elsewhere.

Anthropogenic grassland areas, predominantly found on bluffs and ridges, are among the most extensive in the Western Allegheny Plateau Ecoregion of West Virginia. However, their small size and high ration of edge to grassland interior habitat renders them poor quality for most grassland birds.

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:

- Sand and gravel dredging is permitted in the upper Ohio River (with the ten-year permit granted in 2019).
- Altered flow, pre-Clean Water Act (CWA) water quality degradation, intensive industrial and other development occur along the mainstem Ohio River.
- Natural gas development and infrastructure can fragment and destroy forest habitat.

In addition to this list of general stresses, this Action Plan will list more specific local stresses affecting priority SGCN in each major habitat type.

Conservation Actions

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

- Reconnect fragmented river habitat by modifying operational regimes to improve aquatic organism passage.
- Implement approaches that assure stream segments with high water quality are maintained.
- Limit disturbances to the river bottom.
- Incorporate steps to reduce forest habitat loss and fragmentation in planning for gas well developments, as well as associated infrastructure.

This section of the mainstem Ohio River has great potential for mussel restoration in those areas that are not impacted by commercial sand and gravel dredging. Additional improvements in water quality are needed and stream segments with high water quality need to be maintained.

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

Potential Partners

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

- WVDEP
- USACE
- Oglebay Good Zoo
- USFWS
- ORSANCO
- Corporate Landowners along the Ohio River

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

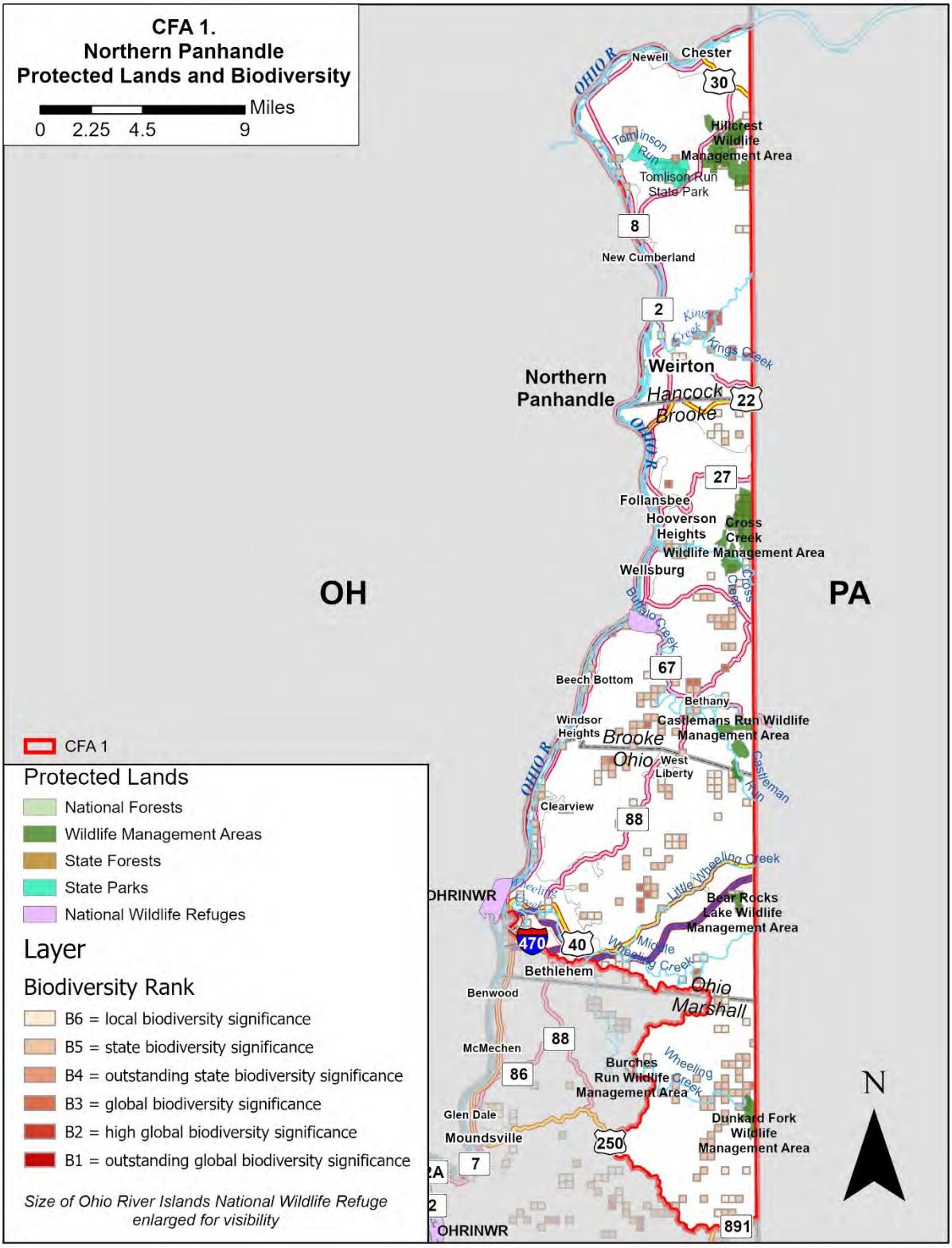
Public lands that may provide significant opportunities for wildlife conservation include:

- Hillcrest WMA
- Cross Creek WMA
- Castleman Run WMA
- Burches Run WMA
- Bear Rocks WMA
- Dunkard Fork WMA
- Tomlinson Run State Park
- Ohio River Islands National Wildlife Refuge

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

Map 5 shows the location of public lands 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 500- square meter 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 in the CFA and there may be opportunities for WVDNR, public agencies and landowners to protect them there. 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 to which conservation activities to protect targeted species will also benefit a suite of other species occupying the same habitat or niche;
- conservation opportunities and likelihood of conservation success in the CFA;
- and other factors.

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

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

Table 4. Priority Species in the CFA

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK
Birds	Ammodramus henslowii	Henslow's Sparrow	S1B	G4
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5
Birds	Butorides virescens	Green Heron	S3B	G5
Birds	Chaetura pelagica	Chimney Swift	S3B	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK
Birds	Dolichonyx oryzivorus	Bobolink	S3B	G5
Birds	Falco sparverius	American Kestrel	S3B	G5
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5
Birds	Megaceryle alcyon	Belted Kingfisher	S3B	G5
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5
Birds	Riparia riparia	Bank Swallow	S2B	G5
Birds	Scolopax minor	American Woodcock	S3B	G5
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4
Birds	Setophaga discolor	Prairie Warbler	S3B	G5
Birds	Spizella pusilla	Field Sparrow	S3B, S3N	G5
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5
Butterflies & Moths	Lycaena hyllus	Bronze Copper	S2	G5
Dragonflies & Damselflies	Enallagma antennatum	Rainbow Bluet	S1S2	G5
Dragonflies & Damselflies	Hetaerina titia	Smoky Rubyspot	S1	G5
Fish	Anguilla rostrata	American Eel	S2	G4
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4
Fish	Etheostoma Tippecanoe	Tippecanoe Darter	S2	G3G4
Fish	Notropis blennius	River Shiner	S2	G5
Fish	Percina shumardi	River Darter	S1	G5
Fish	Phenacobius mirabilis	Suckermouth Minnow	S3	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK
Fish	Polyodon spathula	Paddlefish	S1	G4
Mammals	Lasiurus cinereus	Hoary Bat	S3	G5
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2G3
Mammals	Myotis sodalis	Indiana Bat	S1	G2
Plants	Lechea minor	Thymeleaf Pinweed	S1	G5
Plants	Potamogeton tennesseensis	Tennessee Pondweed	S2	G2
Plants	Prenanthes crepidinea	Corymbed Rattlesnake-root	S1	G4
Plants	Trifolium stoloniferum	Running Buffalo Clover	S3	G3
Reptiles	Apalone spinifera spinifera	Eastern Spiny Softshell	S4	G5T5
Snails	Anguispira kochi	Banded Tigersnail	S1	G5

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

Four Forest habitat types are present within the Northern Panhandle CFA: Dry-Mesic Oak Forests, Mixed Mesophytic Forests, Dry Oak (Pine) Forests and Northern Hardwood Forests. Dry Mesic Oak Forests and Mixed Mesophytic Forests are the most abundant forest habitat types present in the CFA, covering 35% and 18% of the CFA respectively. Dry Mesic Oak Forests are the more dominant habitat type in the northern portion of the CFA, transitioning to Mixed Mesophytic Forests toward the south. Small patches of Northern Hardwood Forests can be found scattered throughout the CFA, with heavier groupings present in the portion of the CFA north of Weirton. 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. Map 6 and 7 display forest habitat types and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) within the CFA. The diversity of forest types across elevational gradients provides opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches may provide core habitat for a significant portion of the SGCN, as well as a matrix of forest habitat types and corridors within which forest species may shift and adapt to climate change.

Also included in Map 7 are rare barren, cliff and talus habitat embedded in forested landscapes. Most of the acidic rock outcrops, cliffs and talus in the CFA occur along the Ohio River. Calcareous cliffs and talus can be found in the southern half of the CFA, along parts of the Ohio River and Wheeling Creek. Several occurrences of rare species have been found in or near these habitat types. These habitats are threatened by nonnative invasive plants, woody encroachment, quarrying and other development. Those found in smaller forest patches may be more vulnerable to stresses. Protected rocky outcrops, cliffs and talus support many unique species and, while the majority of rocky habitat species have evolved adaptations to disturbance events, climate change and the increasing occurrence of disturbances could lead to further endangerment of rare species. These rare habitats require careful management within the forested landscapes.

Priority Species

Table 5 lists priority species in the CFA associated with forest and woodland habitats.

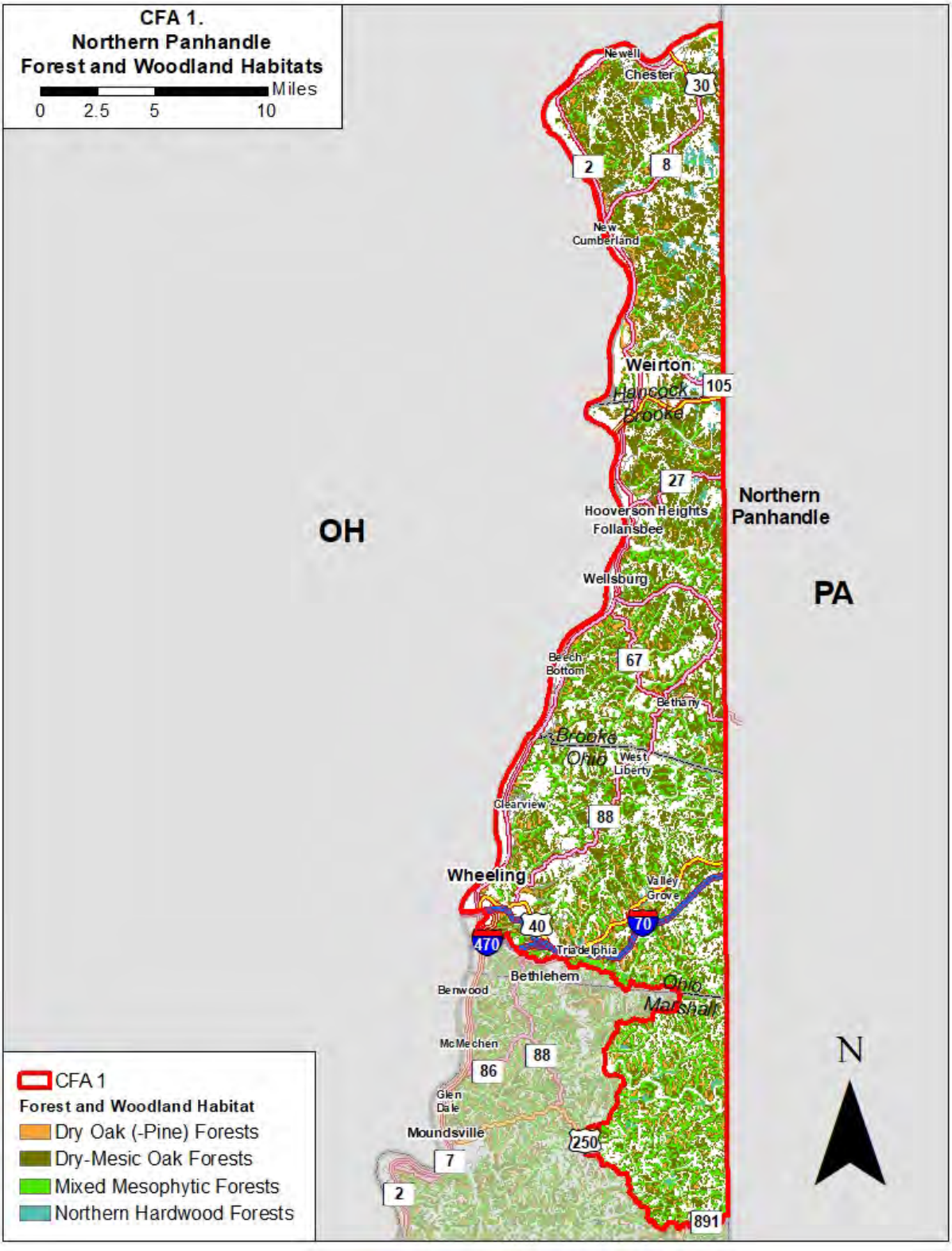
Table 5. Priority Species in Forest and Woodland Habitats

Taxa	Scientific Name	Common Name
Birds	Buteo platypterus	Broad-winged Hawk
Birds	Geothlypis formosa	Kentucky Warbler
Birds	Haliaeetus leucocephalus	Bald Eagle
Birds	Hylocichla mustelina	Wood Thrush
Birds	Icteria virens	Yellow-breasted Chat
Birds	Setophaga cerulea	Cerulean Warbler

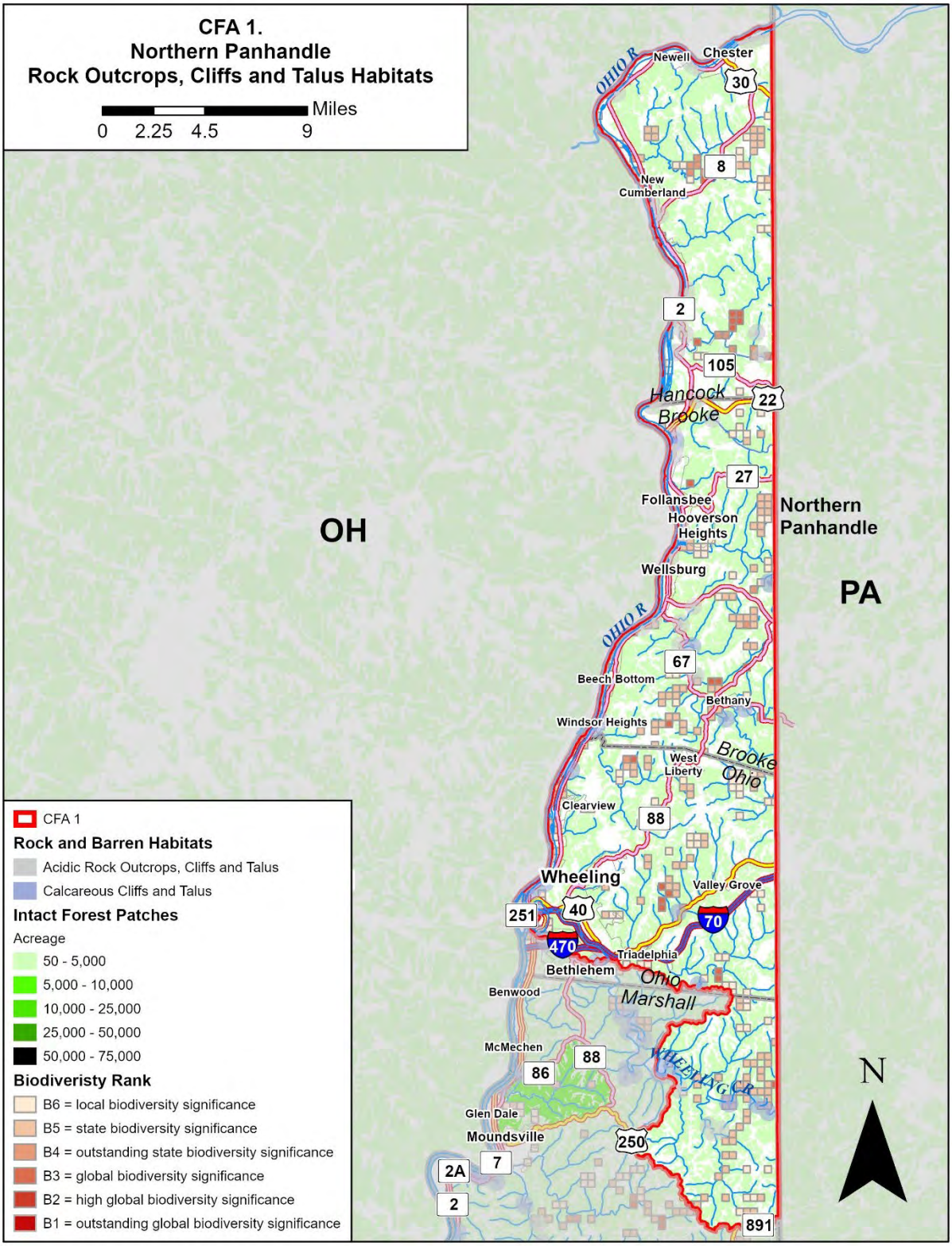
Taxa	Scientific Name	Common Name
Birds	Setophaga discolor	Prairie Warbler
Birds	Vermivora cyanoptera	Blue-winged Warbler
Mammals	Lasiurus cinereus	Hoary Bat
Mammals	Myotis septentrionalis	Northern Myotis
Mammals	Myotis sodalis	Indiana Bat
Plants	Lechea minor	Thymeleaf Pinweed
Plants	Trifolium stoloniferum	Running Buffalo Clover
Snails	Anguispira kochi	Banded Tigersnail

Intact forest patches may support forest interior breeding birds, including Broad-winged Hawk, Wood Thrush and Cerulean Warbler. Early successional forest habitats support species such as the 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.

Map 6. Forest and Woodland Habitats



Map 7. Rock Outcrop, Cliff & Talus Habitats and Forest Patches



Habitat Stresses and Conservation Actions

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

Table 6. Stresses and 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 complexity and habitat diversity.
Deer browse impacting forest structure	Manage local deer populations where abundant
Deforestation, forest fragmentation, climate change and disturbance of rare habitats and hydrological features	Maintain and protect forest cover and hydrology, especially around seeps, streams, bogs, cliffs, talus, rocky substrates, caves and other rare habitat features. Follow forestry BMPs.
Interior forest habitat: deforestation, fragmentation, poor forest structure	Protect interior forest and promote structural complexity: old growth, small openings with well-developed understories, snags and decaying logs, large roosting trees (Hoary Bat)
Early successional habitat: Poor forest structure, forest maturation, fire suppression	Use forest management and prescribed fire to promote early-successional habitat across 15-20% of forested landscapes and structural complexity, including gaps with healthy native grasses, forbs, vegetative cover and snags
Fragmentation of core forests from energy and other development	Develop state-level guidance on siting and construction of energy infrastructure to avoid fragmentation of core forests, and mitigate for impacts by protecting additional core forests
Incompatible utility corridor management	Improve vegetation management practices and timing in utility corridors; reduce broadcast herbicide applications
Invasive plants: forest fragmentation, climate change	Maintain forest cover and control invasive plants, especially around rare habitat features
Woody encroachment around rare plants	Survey, timber management and prescribed burning to create openings
Loss of river bluff habitat (for Banded Tigersnail)	Protect river bluff forests

In addition to the habitat-linked stresses listed above, direct stresses to priority species include lead poisoning of Bald Eagles.

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 SGCN.

Climate Change and Habitat Resilience

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

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

Dry Oak Pine Forests and Pine-Oak Rocky Woodlands are adapted to heat, drought, fire and may benefit from climate change. However, droughts may increase susceptibility to forest pests and pathogens. It may also 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. Protecting large forest blocks in areas with complex topography and maintaining natural cover linkages between them may further enable their adaptation and shifting distribution across the landscape.

Table 7 provides a summary of climate stresses on forest habitats and actions which could boost their resilience (Swanston et al, 2016). While climate stresses are listed separately, forest and woodland habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions resemble previously listed conservation actions to reduce stress on priority species, meaning that they could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners can select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Table 7. Climate Stresses and Resilience Actions in Forest and Woodland Habitats

Climate Stresses	**Habitat Resilience Actions**
• Increased spring and summer temperatures • Increased risk of drought and wildfire • Increased frequency and severity of storms • Increased competition from nonnative invasive species, pests and pathogens	• Restore or maintain fire in fire-adapted ecosystems • Manage deer populations 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. As a starting point, the development of land use and forest management plans by counties, public land managers and private landowners can incorporate many actions to meet landowner goals and improve forest habitat and may be further supported by the WV Division of Forestry and consulting foresters, forest carbon programs, landowner incentive programs and sustainable forestry certification programs.

Table 8. Implementation Plan for Forest and Woodland Habitats

Action	**Partners**	**Effectiveness Measures**
Forest Habitat, Reserve and Corridor Protection: • Conservation Easements • Land Acquisition • Natural Area designation	• The Nature Conservancy • WV Agricultural Land Protection Authority • WV Land Trust • WVDNR • WVDOF Forest Legacy	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Forest Planning & Management: • Land Use Plans • Forest Management Plans • Forest Carbon Programs • Cost-Share Programs • Sustainable Forestry Certification Programs	• AFF • AFTS, FSC, SFI • Consulting Foresters • Forest Carbon Programs • Planning Commissions • Public Land Managers • USDA NRCS • WVDOF	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Manage forests at landscape scale for diversity of native species and age classes, structural and spatial complexity appropriate for the forest type	• AMJV • Consulting Foresters • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species

Action	Partners	Effectiveness Measures
Improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites CERW guidelines for large forest patches with > 70% forest cover: Provide heterogenous stand structure and species diversity with 40-90 ft2/acre residual basal area of well-spaced, large diameter trees (favor white oak, hickories, sugar maple) with canopy gaps and well-developed understory vegetation. Mesic north- and east-facing slopes optimal.	• Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Create or maintain early-successional habitat (ESH) to benefit wildlife species through forest management on appropriate sites. Apply GWWA guidelines for large forest patches with > 70% forest cover: • Maintain ESH on 15-20% of forest at any one time, as part of shifting mosaic ESH should include irregular, interspersed clumps of shrubs and/or saplings, grasses and forbs, and widely spaced overstory trees (10-30% canopy cover or 20-40 ft2/acre residual basal area)	• Consulting Foresters • NWTF and RGS • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Forest management to prevent woody encroachment or avoid disturbance of rare plants, create forest canopy gaps and vegetative cover	• Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species

Action	Partners	Effectiveness Measures
Promote diversity of native species and age classes in forested areas and restore native forest vegetation on adjacent degraded lands through planting and silviculture	• Consulting Foresters • Public Land Managers • USDA NRCS • WVDOF • WVU Extension	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Monitor and control invasive species, pests and pathogens, promptly revegetate disturbed sites	• Public Land Managers • USDA NRCS • WVCA and NPCD • WVDNR, WVDOA, WVDOF	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance and diversity of priority species
Manage deer population where abundant	• Private landowners • Public Land Managers • WVDNR (hunting licenses)	• Change in deer population or forest structure • Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	• Landowners, partners and utility companies	• Acres of habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Controlled burning by public agencies in fire adapted ecosystems	• Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Minimize impact on fragile habitat	• Public Land Managers • Quarries and developers	• Acres of habitat protected for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Public & Landowner Outreach and Demonstration	• Public Land Managers, Oglebay Good Zoo • USDA NRCS • WVCA and NPCD • WVDNR, WVDOA, WVDOF • WVU Extension	• # Landowners engaged • # Landowners implementing actions

Human Benefits

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

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from warm, low-gradient headwater streams such as Tomlinson Run in the north, to warm, moderate gradient large sized rivers such as the Ohio River running along the western boundary of the CFA. 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

Tables 9 and 10 list priority species in the CFA that occur in rivers and streams, floodplains, riparian and wetland habitats. The Pink Mucket (Lampsilis abrupta), Sheepnose (Plethobasus cyphyus), Clubshell (Pleurobema clava) and Rabbitsfoot (Quadrula cylindrica) mussels occurred historically but are believed to be extirpated in this CFA.

Table 9. Priority Species in Aquatic Habitats

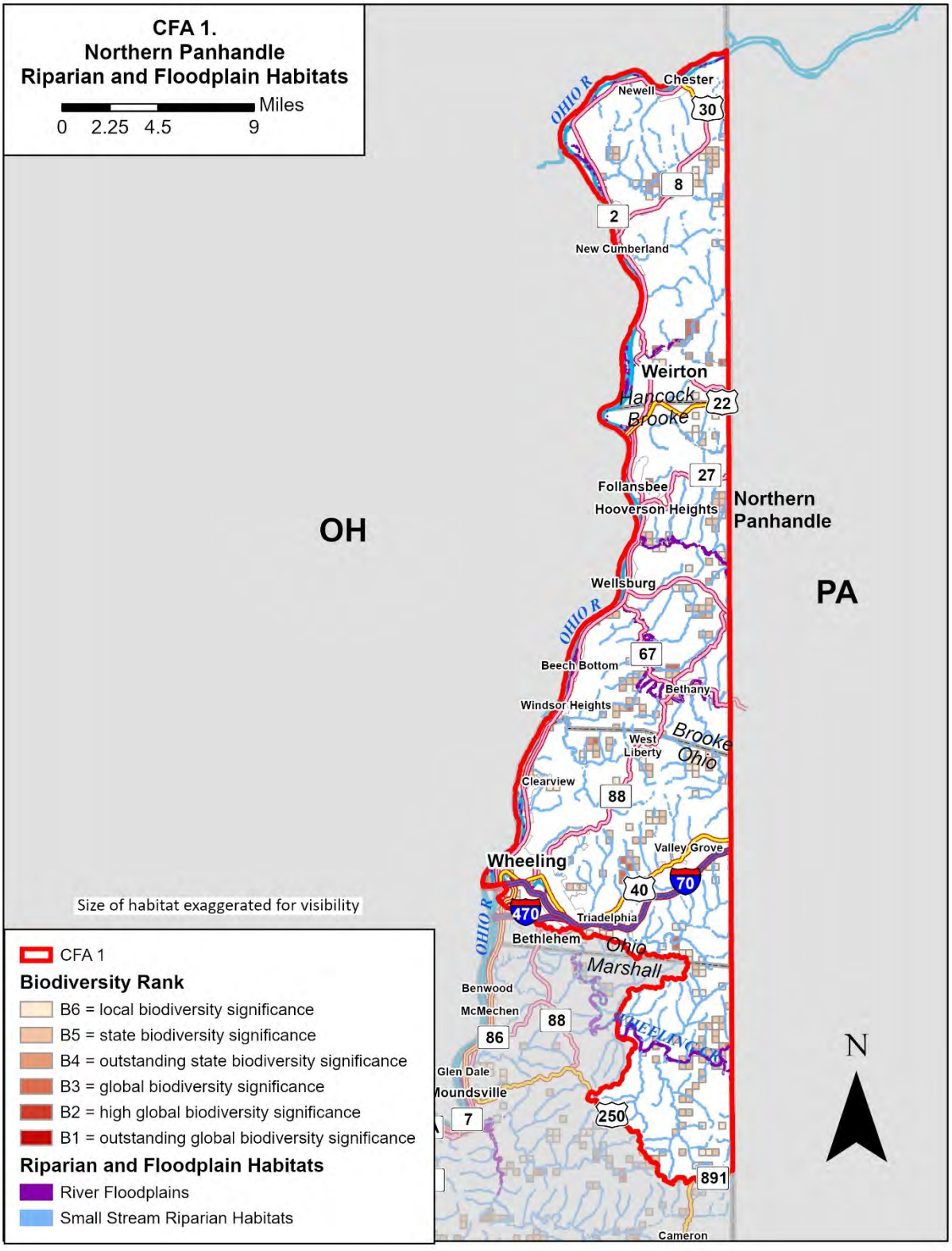
Taxa	**Scientific Name**	**Common Name**
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender
Dragonflies and Damselflies	Enallagma antennatum	Rainbow Bluet
Reptiles	Apalone spinifera spinifera	Eastern Spiny Softshell
Fish	Anguilla rostrata	American Eel
Fish	Clinostomus elongatus	Redside Dace
Fish	Etheostoma tippecanoe	Tippecanoe Darter
Fish	Notropis blennius	River Shiner
Fish	Percina shumardi	River Darter
Fish	Phenacobius mirabilis	Suckermouth Minnow
Fish	Polyodon spathula	Paddlefish

Table 10. Priority Species in Floodplains, Riparian and Wetland Habitats

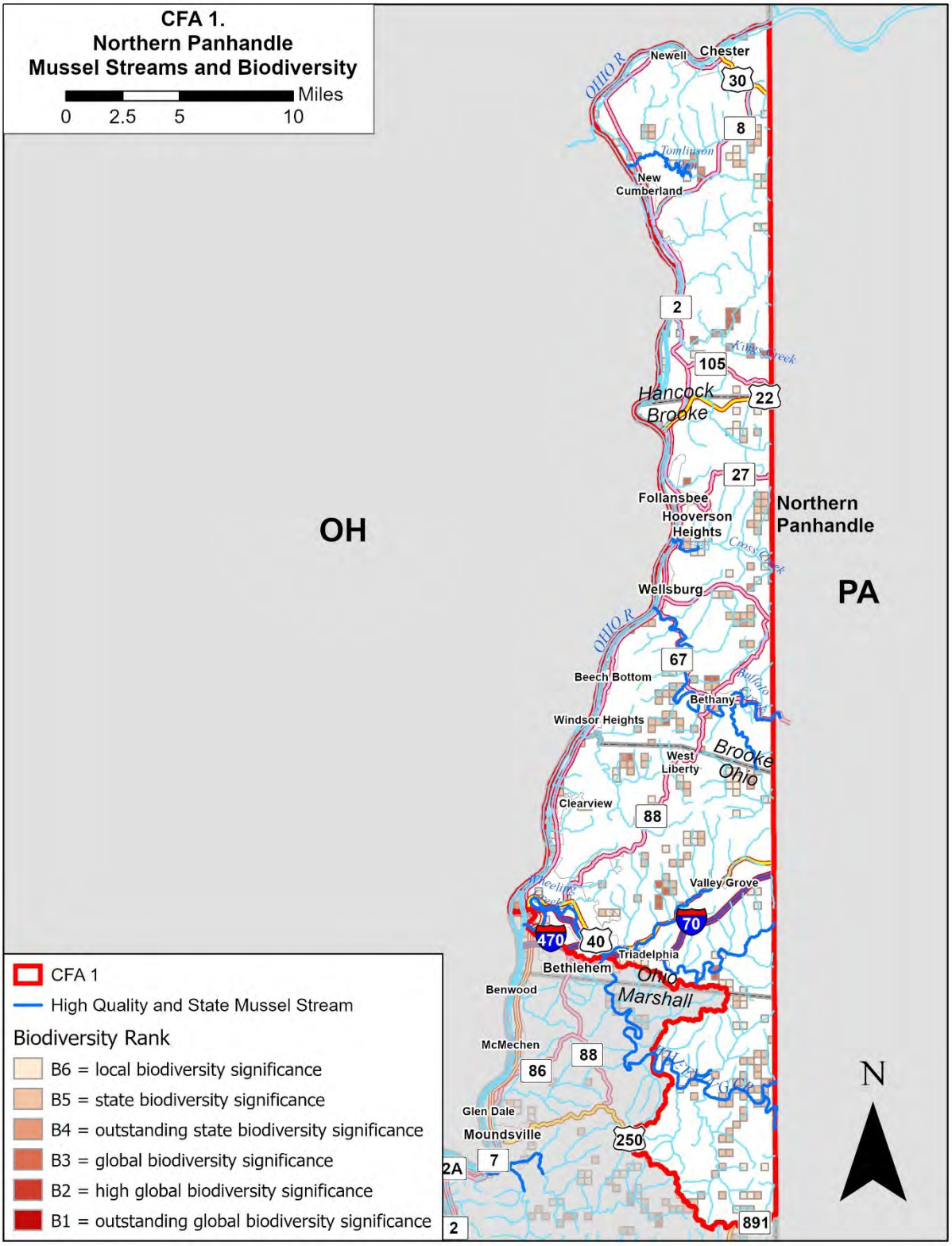
Taxa	Scientific Name	Common Name
Birds	Scolopax minor	American Woodcock
Birds	Butorides virescens	Green Heron
Birds	Geothlypis formosa	Kentucky Warbler
Birds	Haliaeetus leucocephalus	Bald Eagle
Birds	Megaceryle alcyon	Belted Kingfisher
Birds	Parkesia motacilla	Louisiana Waterthrush
Birds	Riparia riparia	Bank Swallow
Birds	Spizella pusilla	Field Sparrow
Dragonflies and Damselflies	Hetaerina titia	Smoky Rubyspot
Mammals	Lasiurus cinereus	Hoary Bat
Mammals	Myotis septentrionalis	Northern Myotis
Mammals	Myotis sodalis	Indiana Bat
Plants	Potamogeton tennesseensis	Tennessee Pondweed
Plants	Trifolium stoloniferum	Running Buffalo Clover
Plants	Prenanthes crepidinea	Corymbed Rattlesnake-root
Reptiles	Apalone spinifera spinifera	Eastern Spiny Softshell

Maps 8 and 9 illustrate riparian and floodplain habitats, mussel streams (mapped by WVDNR in 2018) and biodiversity. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. The B-Rank occurrences indicate that numerous SGCN and rare communities occupy stream, floodplain and riparian habitats. Small stream riparian habitats are visible throughout the CFA along various streams and rivers and their tributaries. River floodplains occur along sections of the Ohio River, Wheeling Creek in the southern end of the CFA, Buffalo Creek and Cross Creek in the central area and the lower stretches of Kings Creek in the north. Several designated State Mussel Streams can be found within the CFA, including: Wheeling Creek, Middle Wheeling Creek and Little Wheeling Creek, as well as Buffalo Creek, Castleman Run and Tomlinson Run. Aquatic and riparian habitats outside of forest patches may be more vulnerable to stresses.

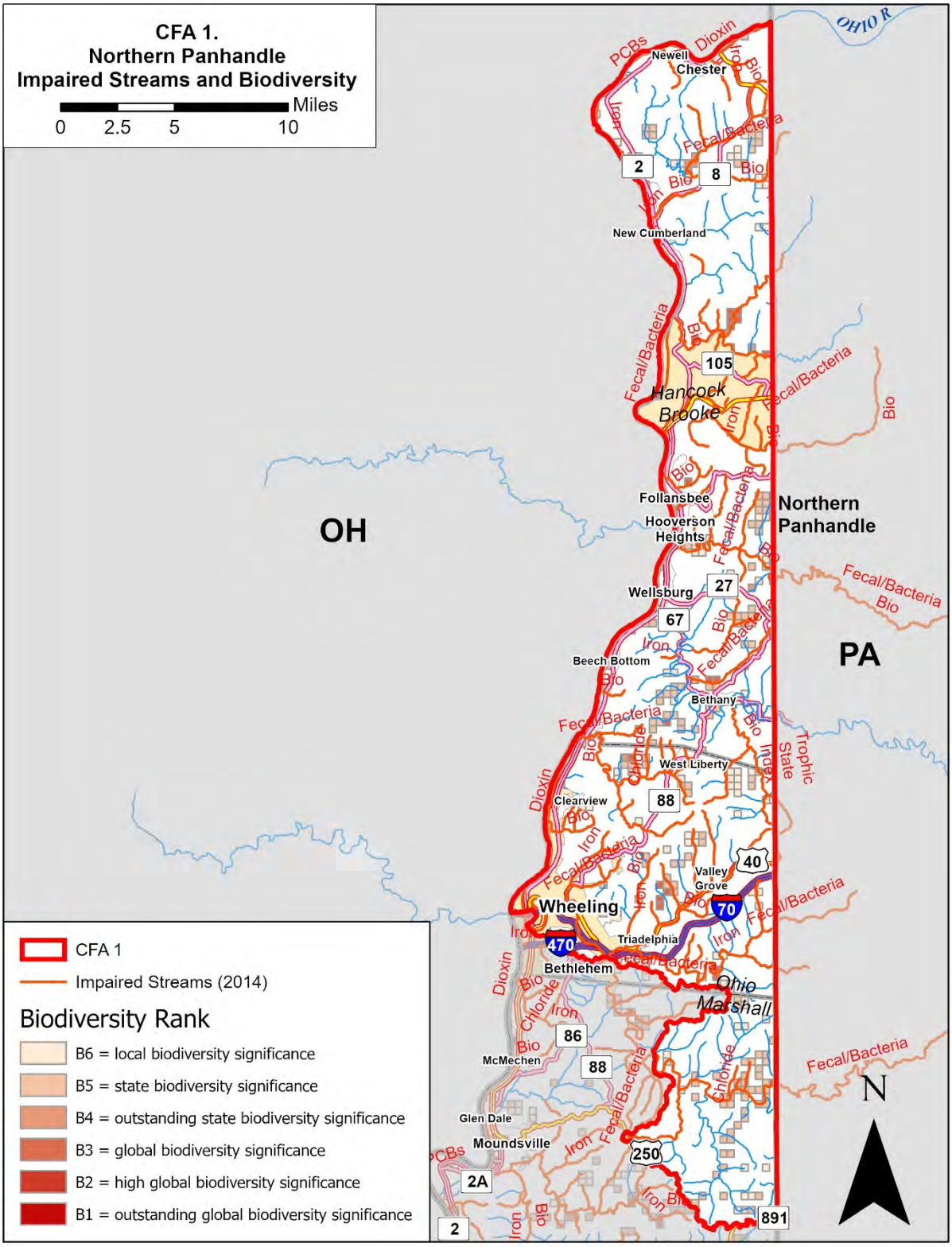
Map 8. Riparian and Floodplain Habitats



Map 9. Mussel Streams and Biodiversity



Map 10. Impaired Streams and Biodiversity



Habitat Stresses and Conservation Actions

Protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly and plant species. Direct stresses to priority species include overhunting of the American Woodcock, where a decline in migrant woodcocks could increase pressure on breeding pairs. Eastern Hellbenders are also directly impacted by disease, illegal collections, rock piling. They are also killed by anglers. These impacts can be prevented by education about decontamination procedures, reducing habitat impacts and increased surveying at known sites.

Map 10 shows stream impairments, along with biodiversity. Numerous streams and rivers within the CFA have been impaired from various causes, the most heavily impaired includes waterways such as: Deep Gut Run, Glenns Run and the upper north section of the Ohio River, all of which suffer from at least four known causes of impairment (WVDEP, 2016). The most common cause of impairment affecting streams and rivers within the CFA are fecal/bacteria and biological (WVDEP, 2016). A table displaying a full list of streams and their impairments can be found in appendix 4. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present.

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

Habitat Stress	**Conservation Action**
Intensive floodplain development: lack of protected floodplain, wetlands, island, shoal, sandy beaches, sand bar and riparian habitat	Habitat protection, especially for priority species, through land use planning, conservation easements and other programs and activities
Water quality degradation (organic and chemical pollutants, sedimentation, run-off, dredging)	Pollution control, improved sewage treatment, storm water management, sediment load reductions, plant and protect riparian buffers
Riparian habitat disturbance and deforestation, road crossings, river channelization, altered hydrology, increased runoff and stream temperatures, climate change	Landowner outreach; Restore and protect forested riparian corridors; Restore stream and floodplain interactions; Minimize disturbance
Sediment, runoff, water withdrawals and water quality degradation from oil/gas development	Increased coordination with WVDNR, maintain forested riparian corridors, minimize disturbance, reduce sediment inputs and manage water withdrawals, implement unconventional oil & gas BMPs
Aquatic passage barriers	Modify or remove barriers
Sand and gravel dredging	Identify priority species and habitats to avoid and work with dredging companies and regulators on avoidance measures. Survey and salvage mussels prior to dredging.

Habitat Stress	Conservation Action
Flow alteration by locks and dams, including sediment deposition at stream confluences	Work with dam operators and regulators to optimize flow conditions for priority species
Trash attracts carnivores and increases predation, especially on sandy beaches used for nesting by birds and turtles	Trash clean-ups especially on sandy beaches
Degradation of wetlands	Maintain wetland integrity, protect wetland habitats and vegetated buffers

In addition to the habitat-linked stresses listed above, common direct stresses affecting multiple priority species associated with this habitat includes increased stream sedimentation, increased stream temperature and point and nonpoint-source pollution.

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 and species such as Hellbenders 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 12 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 12. Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat

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

Implementation Plan

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

Table 13. Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition	• The Nature Conservancy • USDA NRCS • WV Agricultural Land Protection Authority • WV Land Trust • WVDNR	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats

Action	Partners	Effectiveness Measures
Habitat Protection • Incentive Programs	• USDA FSA	• Acres of aquatic and riparian habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection: • Land Use Planning	• County Planning Commissions	• Acres of habitat protected through land use planning, floodplain and stormwater regulations
In-stream and riparian habitat restoration	• Public Land Managers • Trout Unlimited • US Army Corps of Engineers • USDA • USFWS Partners for Fish and Wildlife • WVCA, NPCD • WVDEP • WVDNR	• Acres or linear feet of in-stream and riparian habitat restored for priority species • Before and after comparison: abundance and diversity of priority species
Planting and fencing stream buffer zones	• USDA • USFWS Partners for Fish and Wildlife • WVCA, NPCD • WVDEP, WVDOF	• Acres or linear feet of stream buffer zones planted and fenced to protect priority species • Before and after comparison: abundance and diversity of priority species
Remove or improve stream crossing and other barriers to provide aquatic organism passage	• Trout Unlimited • US Army Corps of Engineers • USDA • USFWS • WVDOH	• # barriers removed or improved • # miles stream habitat opened • Before and after comparison: abundance and diversity of priority species
Improved wastewater and stormwater treatment	• County governments • WVDEP • WVDHHR	• # wastewater and stormwater systems installed or improved • Change in fecal, sediment and other water quality measurements • Before and after comparison: abundance & distribution of priority species

Action	Partners	Effectiveness Measures
Improve water quality in streams and wetlands	• USDA • WVCA and NPCD • WVDEP	• Change in water quality measurements • Before and after comparison: abundance and diversity of priority species
Avoid priority species and habitats in dredging operations. Survey and salvage mussels prior to dredging.	• Dredging companies and regulators	• # species and acres of habitat avoided
Optimize flow conditions through locks and dams for priority species	• Lock and dam operators and regulators • US Army Corps of Engineers	• # species and miles of habitat with improved flow conditions
Trash clean-ups, especially on sandy beaches	• Community groups • WVDEP	• Acres or stream length treated
Improve management of water withdrawals, implement unconventional oil & gas BMPs to avoid impacts on priority species	• Oil and gas companies • WVDEP, WVDNR	• # species and miles of habitat with improved flow or habitat conditions
Treat invasive plants in riparian corridors and wetlands	• USDA • USFWS Partners for Fish and Wildlife • WVCA, NPCD • WVDEP, WVDOA	• Acres treated • Treatment success rate • Before and after comparison: abundance and diversity of priority species
Public & Landowner Outreach and Demonstration	• Oglebay Good Zoo • Public Land Managers, • USDA • WVCA and NPCD • WVDEP, WVDNR, • WVDOA, WVDOF • WVU Extension	• # Landowners engaged • # Landowners implementing actions

Human Benefits

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

Subterranean Habitats

Cave Habitats

Caves and karst features provide important habitat for bats that move in and out, as well as a diverse group of vertebrate and invertebrate animals that have evolved specialized adaptations to permanent underground living. Common traits exhibited by permanent cave dwellers (troglobites) include blindness (or complete loss of eyes) and reduced pigmentation. Caves may be influenced by human activities, surface land use and surface and underground hydrology in the surrounding landscape. Map 11 illustrates multiple karst features with 3-kilometer random offset buffers and karst feature density. This data was provided by the West Virginia Speleological Survey, with offset buffers developed by WVDNR. Buffers around karst features are concentrated in the southern portion of the CFA, with the largest grouping of karst features found near the town of Wheeling. These areas require careful management to minimize disturbance on priority species.

Priority Species

Caves in this CFA host the following priority species, all of which are rare and dependent on specific cave habitats for their survival.

Table 14. Priority Species in Cave and Karst Habitats

Taxa	Scientific Name	Common Name
Mammals	Myotis septentrionalis	Northern Myotis
Mammals	Myotis sodalis	Indiana Bat

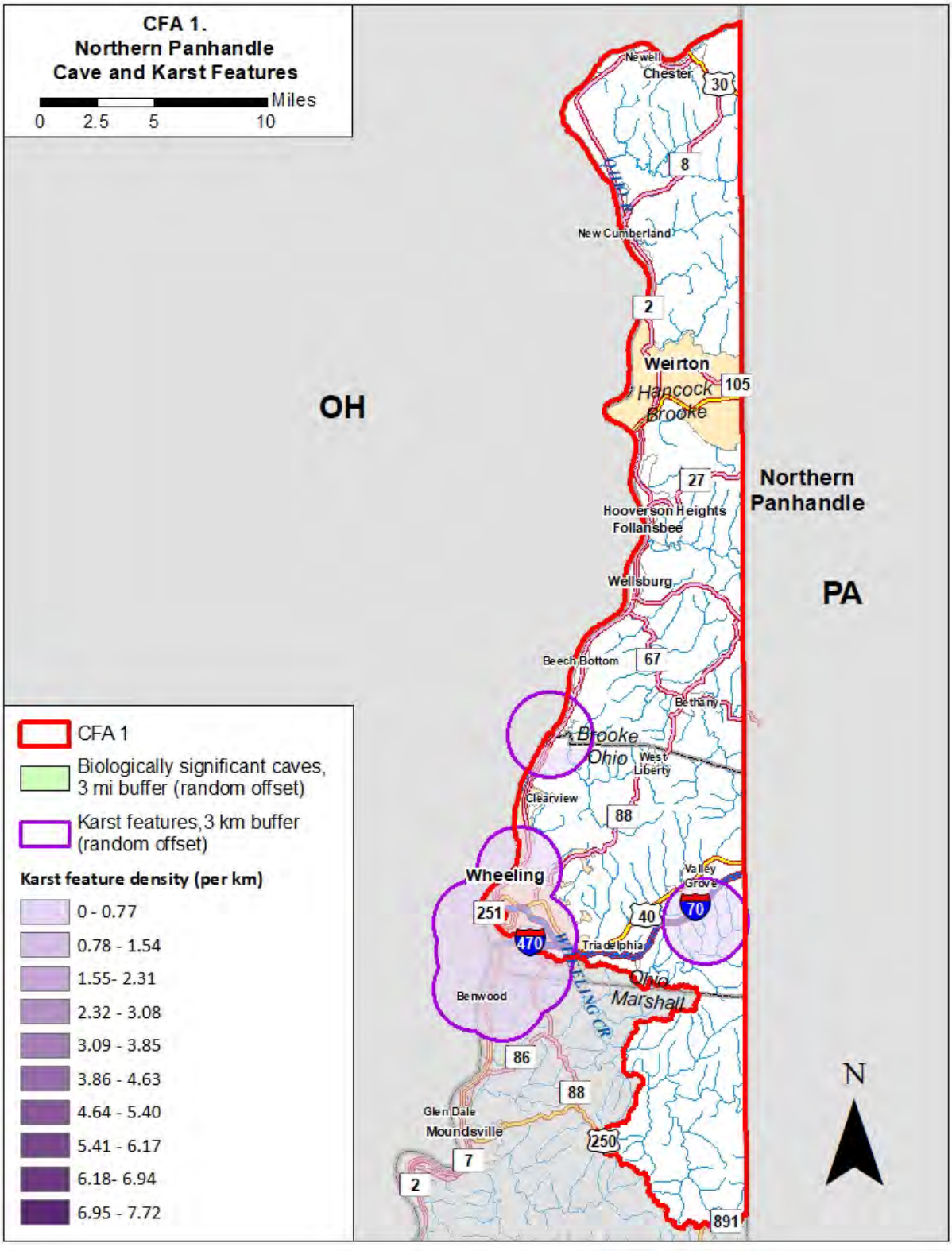
Habitat Stresses and Conservation Actions

Caves and subterranean habitats, particularly in porous karst geology, are closely tied to and impacted by changes to water quality and land use in adjacent areas. Table 15 lists stresses affecting wildlife in caves and subterranean habitats and conservation actions landowners and partners can take to address them.

Table 15. Habitat Stresses and Conservation Actions in Subterranean Habitats

Habitat Stress	Conservation Action
Stormwater runoff, water quality degradation, non-point source pollution	Reduce non-point source pollution sources, e.g. improved stormwater management, wastewater treatment, riparian buffers
Agriculture, industry, development and deforestation around caves	Restore and protect streams and riparian forest corridors

Map 11. Karst and Cave Features



Climate Change and Habitat Resilience

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

Table 16 provides a summary of climate stresses on cave and karst habitats, and actions to boost their resilience. Although climate stresses are listed separately, subterranean habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Some of these actions repeat previously listed conservation actions to reduce stress on priority species and could benefit priority species while also boosting habitat resilience. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Table 16. Climate Stresses and Resilience Actions in Karst and Cave Habitats

Climate Stress:	**Habitat Resilience Action:**
• Increased flood frequency and severity, nutrient inputs and contaminants • Increased surface water temperatures, low-flow events and ground water withdrawals • Impacts to adjacent forest, riparian and aquatic habitat	• Restore and protect surface water quality and hydrology • Limit impervious cover • Maintain ground water quality and quantity • Maintain resilient forests, riparian and aquatic habitat around karst and cave ecosystems

Implementation Plan

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

Table 17. Implementation Plan for Subterranean Habitats

Action	Partners	Effectiveness Measures
Land protection around caves and riparian habitats: • Conservation Easements • Land Acquisition	• The Nature Conservancy • USDA NRCS • WV Agricultural Land Protection Authority • WV Land Trust • WVDNR	• Acres of habitat protected around caves and karst habitat • Abundance and diversity of priority species and habitats
Land protection around caves and riparian habitats • Incentive Programs	• USDA FSA	• Acres of habitat protected Abundance and diversity of priority species and habitats
Land use planning around caves and riparian habitats	• County Planning Commissions	• Acres of cave, karst and buffer habitat protected for public health and safety through land use planning ordinances
Stream buffer fencing and riparian plantings	• Trout Unlimited • USDA FSA • USDA NRCS • USFWS Partners for Fish and Wildlife • WVDOF, WVDEP and WVCA	• Acres or linear feet of stream buffer zones planted and fenced • Before and after comparison: abundance and diversity of priority species
Land management around caves and karst	• Public Land Managers • Trout Unlimited • USDA FSA • USDA NRCS • USFWS Partners for Fish and Wildlife	• Acres of habitat managed • Before and after comparison: abundance and diversity of priority species
Improved water quality, wastewater treatment, sediment control, etc.	• WVDEP • WVDHHR	• # systems installed or improved • Change in fecal and other water quality Before and after comparison: abundance and diversity of priority species

Human Benefits

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

Agricultural and Developed Habitats

Agricultural areas can be found dispersed throughout the CFA, while developed areas are focused in the Wheeling and Weirton areas and along State Route 88 in the southern portion of the CFA and State Route 2 in the north. Many species of wildlife rely on agricultural lands, especially pastures and woody vegetation in fallow areas, abandoned fields, field borders, wetlands and riparian corridors. Anthropogenic grasslands and shrublands established on reclaimed surface mines may also provide valuable habitat and management opportunities. 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. Maintaining pastures, fallow fields, woody vegetation, wetlands and riparian corridors is a priority for SGCN in agricultural habitats, for example, grassland birds such as the Grasshopper Sparrow, American Woodcock and Bobolink rely heavily on agricultural areas.

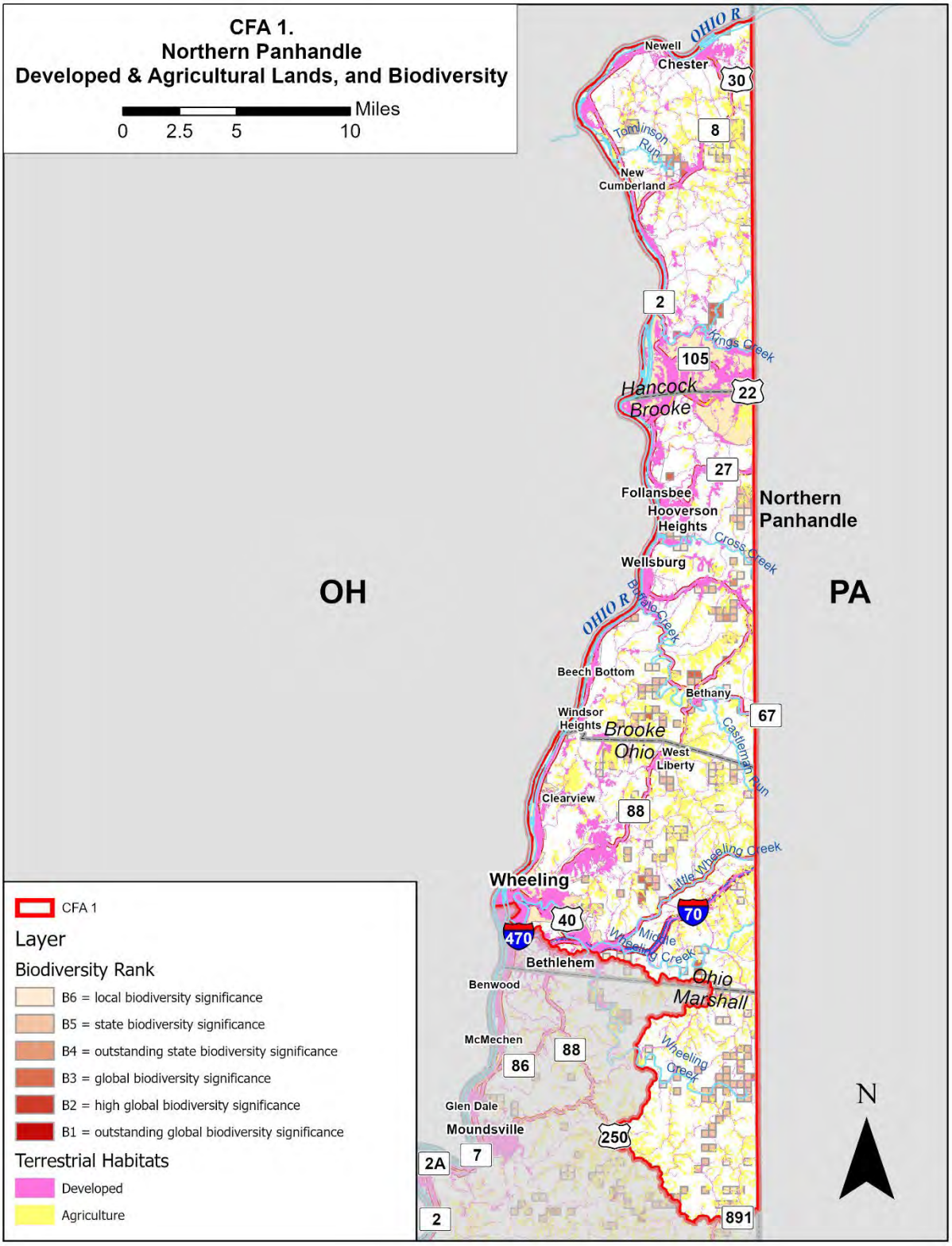
Priority Species

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. Bronze Copper butterflies rely on old fields and wet meadows. The following is a list of priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habit, most notably for the Chimney Swift.

Table 18. Priority Species in Agricultural and Developed Habitats

Taxa	Scientific Name	Common Name
Birds	Ammodramus henslowii	Henslow's Sparrow
Birds	Ammodramus savannarum	Grasshopper Sparrow
Birds	Chaetura pelagica	Chimney Swift
Birds	Dolichonyx oryzivorus	Bobolink
Birds	Falco sparverius	American Kestrel
Birds	Scolopax minor	American Woodcock
Birds	Spizella pusilla	Field Sparrow
Birds	Sturnella magna	Eastern Meadowlark
Butterflies and Moths	Lycaena hyllus	Bronze Copper

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. Table 19 lists stresses to priority species in agricultural and developed habitats, and conservation actions to address them.

Table 19. Stresses and Actions in Agricultural and Developed Habitats:

Habitat Stress	**Conservation Action**
Clean farming practices: loss of grassland, woody veg., wet meadows, old fields, bird breeding and roosting sites	Retain or plant shrubs, hedgerows and hawthorns in pastures; retain and improve grasslands, adjust timing of hay harvest; retain wet meadows and old fields
Loss of early successional habitat in and around agricultural land, overgrazing	Retain early successional habitat with healthy grasses and forbs, monitor grazing impacts and prevent overgrazing
Chimney capping	Uncap chimneys, install towers for chimney swifts, retain hollow snags and logs
Loss of bird habitat and nesting sites	Landowner outreach and education, nest box installation and monitoring (American Kestrel)
Loss of pollinator habitat	Restore and maintain pollinator habitat

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 hayfields and pastures, fallow fields, floodplain and riparian corridors, streams, wetlands and areas of natural vegetation around field and forest edges. In agricultural settings, these areas may already be degraded and sensitive to disturbance. As we have seen in previous sections of this plan, these areas may also be susceptible to impacts from climate change. Riparian forests may be vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation in streams. Drought

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

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

Climate Stress:	**Habitat Resilience Action:**
• Increased flood frequency and severity, erosion and sedimentation • Increased surface water temperatures, low-flow events and water quality degradation • Increased risk of drought and wildfire • Increased competition from nonnative invasive species, pests and pathogens	• Maintain soil health and water quality • Reduce competition from weeds and invasive species • Create pollinator habitat • Maintain, restore and connect aquatic, riparian and forest habitats to buffer against hydrological impacts • Adapt farm practices, infrastructure and land uses to changing conditions • Reduce and buffer impervious surfaces and use green infrastructure to absorb runoff and mitigate hydrological impacts

Implementation Plan

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

Table 21. Implementation Plan for Agricultural and Developed Habitats.

Action	Partners	Effectiveness Measures
Habitat Protection: • Conservation Easements • Land Acquisition	• The Nature Conservancy • USDA NRCS • WV Agricultural Land Protection Authority • WV Land Trust • WVDNR	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection • Incentive Programs	• USDA FSA	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants; retain wet meadows and old fields	• USDA FSA • USDA NRCS	• Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Maintain or restore aquatic, riparian and forest habitat as well as species and structural diversity in natural areas in and around farmland and enhance connections between them	• Public Land Managers • USDA FSA • USDA NRCS	• Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Retain early successional habitat	• Public Land Managers • USDA NRCS	• Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats
Prevent conversion of grasslands to croplands	• USDA FSA	• Acres of grasslands planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Adjust timing and interval of hay harvest	• USDA FSA, NRCS	• Acres of hay fields under adjusted management • Change in abundance, diversity and distribution of priority species and habitats

Action	Partners	Effectiveness Measures
Create and maintain pollinator habitat and nectar resources, including diverse native and non-invasive flowering forbs, shrubs, trees, larval host plants and undisturbed nesting and overwintering areas along field edges, woodlots, water bodies, roads, on fallow fields and other appropriate sites.	• Public Land Managers • USDA NRCS • USFWS Partners for Wildlife Program • WVDOH, WVDNR	• Acres or linear feet of pollinator habitat created or maintained • Change in abundance, diversity and distribution of priority species and habitats
Adapt farm practices, infrastructure and land uses to changing conditions	• Public Land Managers • USDA FSA • USDA NRCS	• # practices or acres adapted • Change in abundance, diversity and distribution of priority species
Landowner outreach, uncapping chimneys, install swift towers and nest boxes for American Kestrels	• Landowners and volunteer groups	• # chimneys uncapped • # swift towers installed • # nest boxes installed • Change in abundance, diversity and distribution of chimney swifts
Public & Landowner Outreach and Demonstration	• Grow Ohio Valley • Public Land Managers, Oglebay Good Zoo • USDA NRCS • WVDEP, WVCA and NPCD • WVDNR, WVDOA, WVDOF • WVU Extension	• # Landowners engaged • # Landowners implementing actions

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.

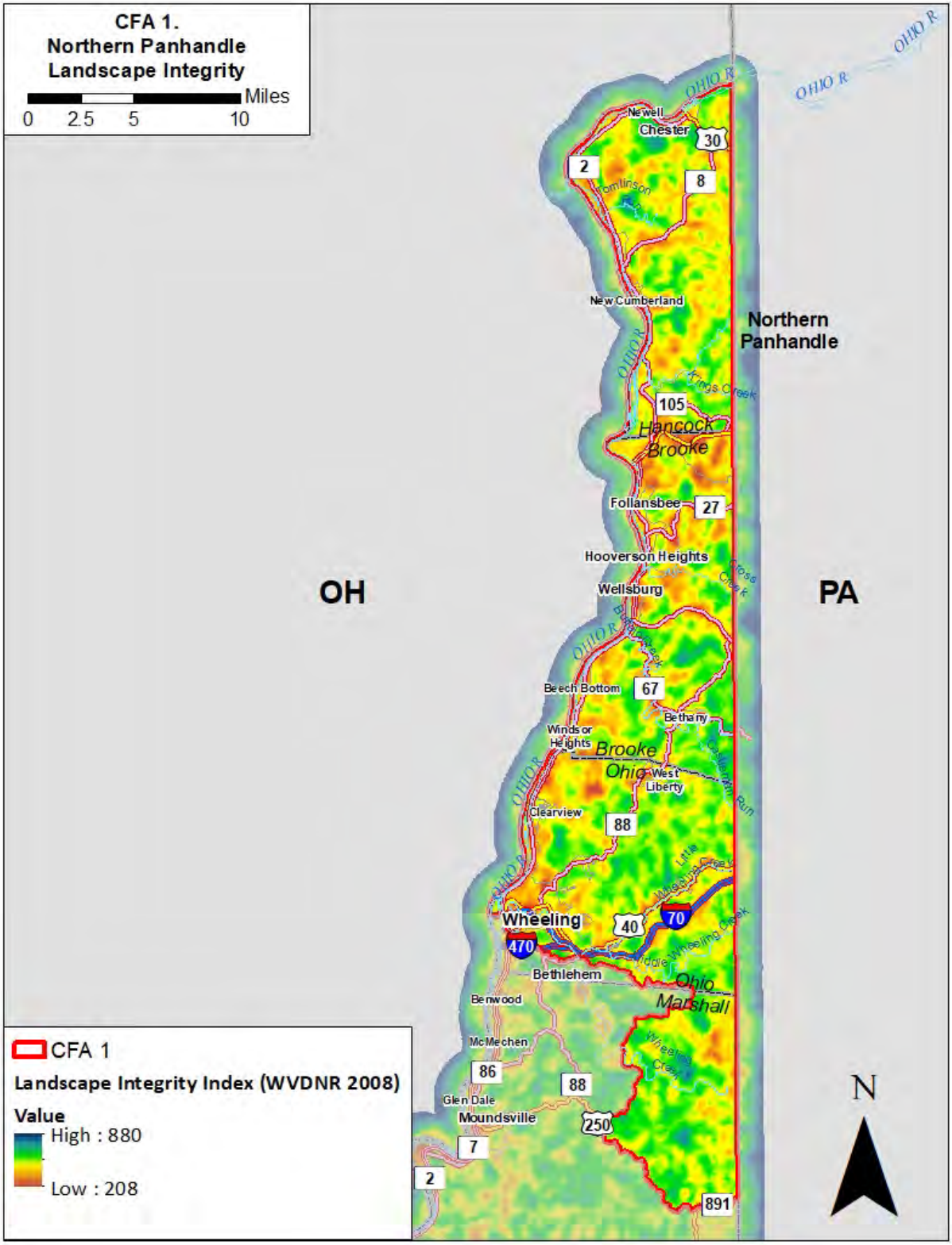
Landscape Resilience and Connectivity

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, 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. Areas with higher integrity landscapes tend to lie within public lands such as Castlemans Run WMA and Cross Creek WMA. There are also landscapes of higher integrity in private ownership adjacent to public lands. These areas are important for species adaptation in response to climate change and are priorities for protection of wildlife habitat.

Map 13. Landscape Integrity



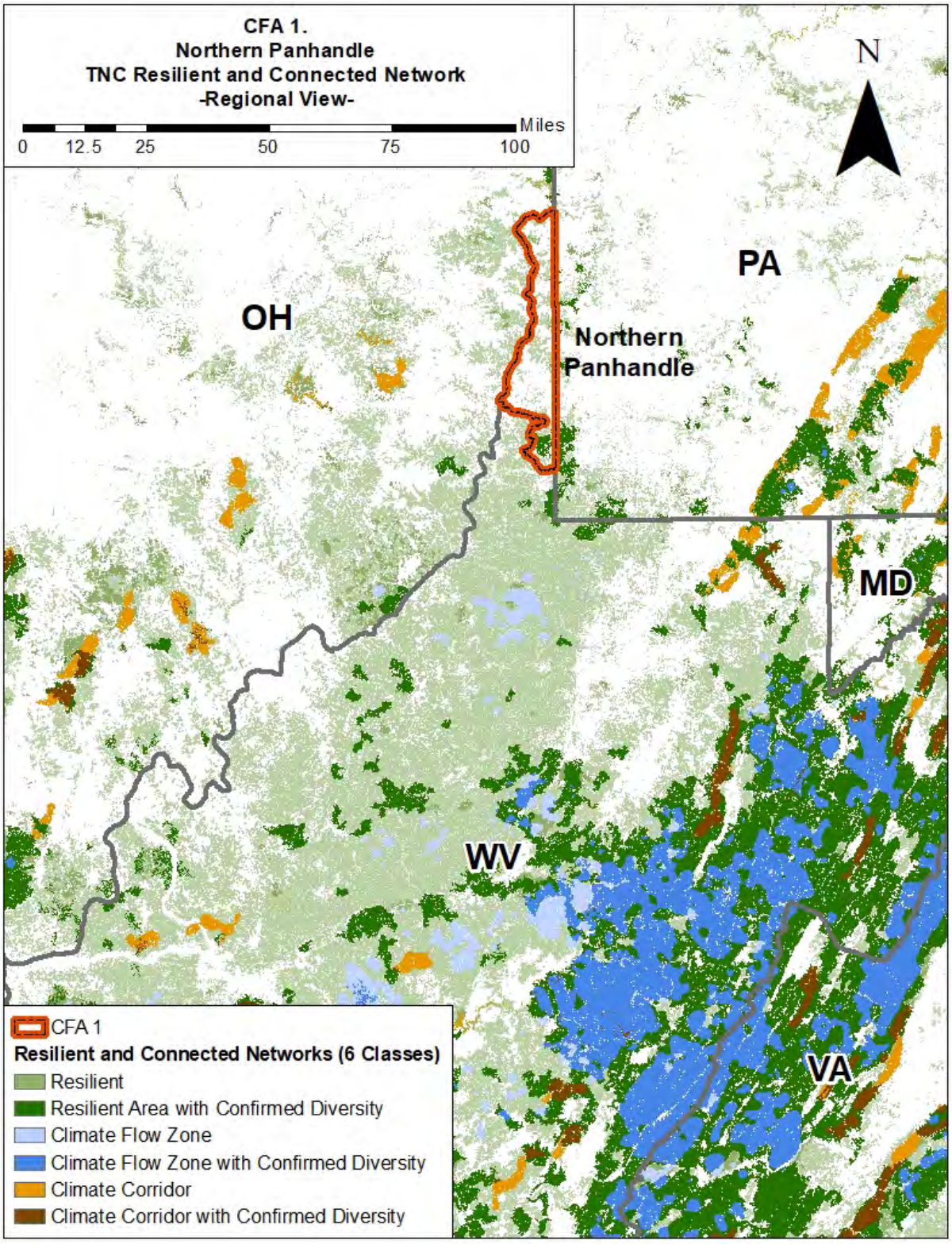
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future 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, high landscape integrity or local connectedness where species can move locally and disperse in response to climate change and where natural processes like fire and floods could continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the movement or flow of species across the landscape over time in response to climate change as constrained by natural and human-caused barriers. This led to the identification of corridors of constrained movement and flow zones of dispersed movement. These are corridors and core areas for species movement and adaptation at a landscape level.

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:

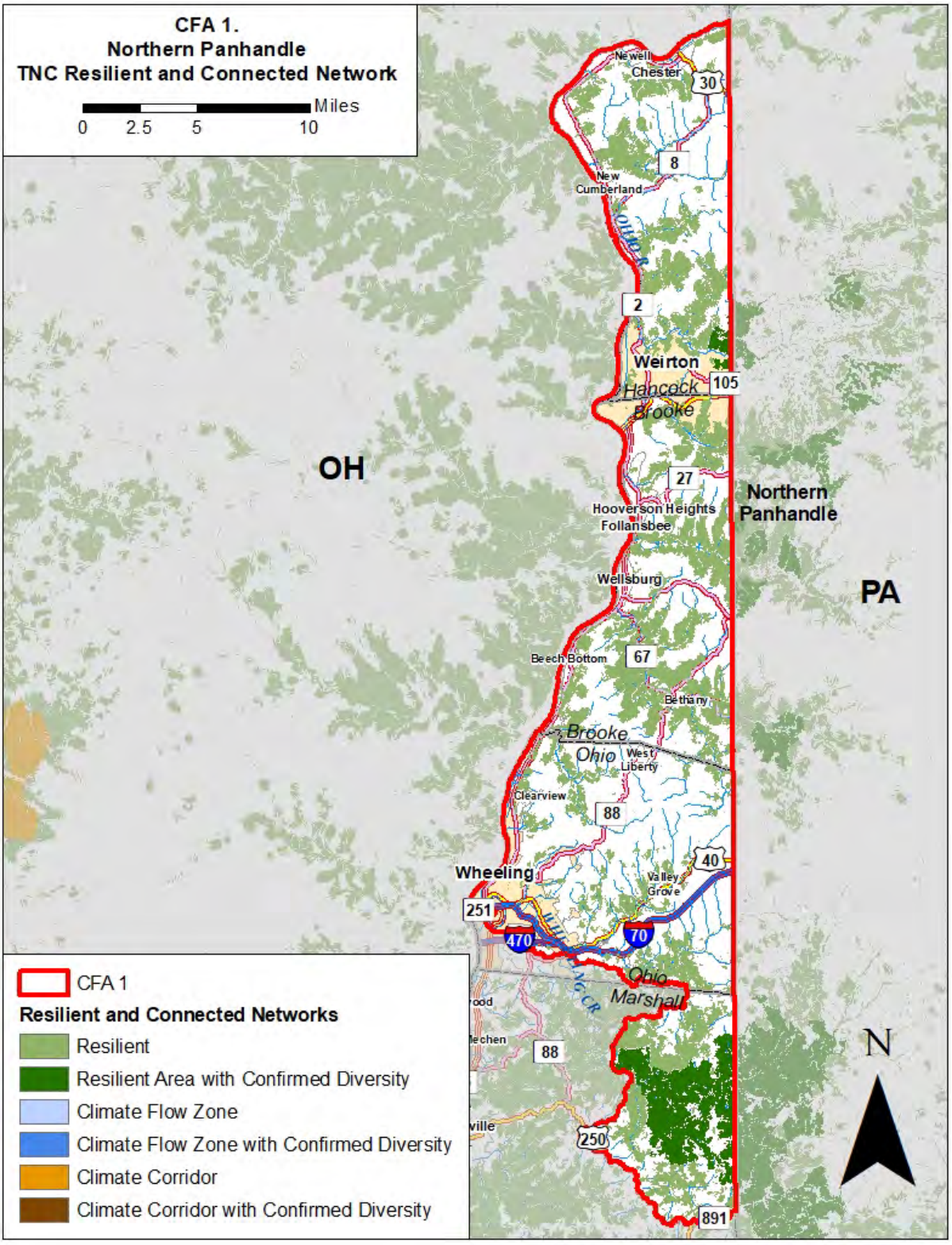
- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes 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 showing that the Northern Panhandle CFA lies toward the northern edge of the larger block of resilient lands in western West Virginia. This part of the state includes a vast matrix of resilient lands with small patches of climate flow zones and areas with confirmed biodiversity. These features are most concentrated in Eastern West Virginia, where there is a large hub of resilient lands and climate flow zones with confirmed biodiversity.

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 Northern Panhandle CFA. Patches of resilient landscapes are present throughout the CFA following the course of various streams feeding into the Ohio River. A large expanse of resilient land with high diversity is found in the southern portion of the CFA near the Burches Run and Dunkard Fork Wildlife Management Areas and along Wheeling Creek. An additional, much smaller, patch of resilient land with high diversity can also be found to the east of Weirton. These patches of resilient land, particularly those with confirmed biodiversity, offer refuge to species as they shift and adapt to climate change.

Protecting and maintaining these areas of high landscape integrity and the resilient areas within the region's priority resilient and connected network is critical in order to enable priority SGCN and their habitat to adapt to climate change and persist in this CFA. These areas are priorities for conservation action within the CFA. Table 22 summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Table 22. Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	Conservation Action
• Changing conditions exacerbating existing stresses on species and habitat • Species responding to climate change by shifting locally as well as across the landscape • Landscape fragmentation that prevents or constrains species movement	• Protect and maintain a connected network of resilient landscapes 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 form part of a larger network of resilient and connected landscapes in West Virginia and Pennsylvania and across 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 23. Implementation Plan for Landscape Resilience and Connectivity

Action	Partners	Effectiveness Measures
Protection of Resilient, Connected Landscapes • Conservation Easements • Land Acquisition	• The Nature Conservancy • USDA NRCS • WV Agricultural Land Protection Authority • WV Land Trust • WVDNR	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Protection of Resilient, Connected Landscapes • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning in resilient, connected landscapes
Protection of Resilient, Connected Landscapes • Incentive Programs • Forest Carbon projects	• Consulting Foresters • USDA FSA • USDA NRCS	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Protection of Resilient, Connected Landscapes • Conservation and Management	• Partner Organizations • Private Landowners • US Forest Service • WV Division of Natural Resources	• 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, barrens, cliffs and talus, caves and karst, aquatic, riparian, floodplain, developed and agricultural habitats. For each major habitat type the plan identifies stresses that affect priority species, conservation actions to reduce those stresses, climate stresses on those habitats, actions to boost resilience, partners that can assist with conservation actions to implement the plan and the human benefits of conservation.

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

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

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

Integration of Conservation Actions

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

Connecting Conservation Actions for Climate Resilience

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

areas of high landscape integrity as well as the regional network of resilient lands 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 rock outcrops, cliff and talus, or cave habitat buffers enhances the resilience of these habitats and enables forest species to move to optimal sites as conditions change. Conservation of aquatic, riparian and floodplain corridors along with areas of native vegetation in and around agricultural areas, small forest patches and larger blocks of forest habitat can create a local network of resilient, connected lands that merges into the larger regional network. Beyond undertaking conservation actions in the priority habitats listed above and protecting the regional network of climate connectors and flow zones, stakeholders are encouraged to restore and protect the connections between these areas in order to maintain an interwoven fabric of natural systems for wildlife within this CFA to thrive long into the future.

Next Steps in Implementation

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

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

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

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Appendix 1. SGCN in the Northern Panhandle CFA

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Amphibians	Cryptobranchus alleganiensis	Eastern Hellbender	S2	G3G4		
Amphibians	Lithobates pipiens	Northern Leopard Frog	S1	G5		
Birds	Actitis macularius	Spotted Sandpiper	S2B	G5		
Birds	Ammodramus henslowii	Henslow's Sparrow	S1B	G4		
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5		
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5		At Risk-Cons
Birds	Ardea herodias	Great Blue Heron	S3B,S4N	G5		
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5		
Birds	Butorides virescens	Green Heron	S3B	G5		
Birds	Chaetura pelagica	Chimney Swift	S3B	G5		
Birds	Circus cyaneus	Northern Harrier	S1B,S3N	G5		
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5		
Birds	Dolichonyx oryzivorus	Bobolink	S3B	G5		
Birds	Empidonax alnorum	Alder Flycatcher	S3B	G5		
Birds	Falco sparverius	American Kestrel	S3B	G5		
Birds	Geothlypis formosa	Kentucky Warbler	S3B	G5		
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5		
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5		At Risk-Cons
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5		
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5		
Birds	Petrochelidon pyrrhonota	Cliff Swallow	S3B	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Birds	Piranga rubra	Summer Tanager	S3B	G5		
Birds	Porzana carolina	Sora	S1B,S1N	G5		
Birds	Riparia riparia	Bank Swallow	S2B	G5		
Birds	Scolopax minor	American Woodcock	S3B	G5		
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4		At Risk-Cons
Birds	Setophaga discolor	Prairie Warbler	S3B	G5		
Birds	Spizella pusilla	Field Sparrow	S3B, S3N	G5		
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5		
Birds	Tyto alba	Barn Owl	S2B,S2N	G5		
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5		
Butterflies & Moths	Celastrina neglectamajor	Appalachian Azure	S3	G4		
Butterflies & Moths	Lycaena hyllus	Bronze Copper	S2	G5		
Cave Invertebrates	Sinella hoffmani	Hoffman's Springtail	S3	G5		
Dragonflies and Damselflies	Cordulegaster obliqua	Arrowhead Spiketail	S2	G4		
Dragonflies and Damselflies	Enallagma annexum	Northern Bluet	S3	G5		
Dragonflies and Damselflies	Enallagma antennatum	Rainbow Bluet	S1S2	G5		
Dragonflies and Damselflies	Hetaerina titia	Smoky Rubyspot	S1	G5		
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5		
Fish	Anguilla rostrata	American Eel	S2	G4		
Fish	Carpiodes carpio	River Carpsucker	S3	G5		
Fish	Carpiodes velifer	Highfin Carpsucker	S1	G4G5		
Fish	Clinostomus elongatus	Redside Dace	S1S2	G3G4		
Fish	Etheostoma Tippecanoe	Tippecanoe Darter	S2	G3G4		
Fish	Hiodon alosoides	Goldeye	S1	G5		
Fish	Ichthyomyzon bdellium	Ohio Lamprey	S2S3	G3G4		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
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	Macrhybopsis hyostoma	Shoal Chub	S2	G5		
Fish	Macrhybopsis storeriana	Silver Chub	S3	G5		
Fish	Moxostoma carinatum	River Redhorse	S3	G4		
Fish	Notropis blennius	River Shiner	S2	G5		
Fish	Percina copelandi	Channel Darter	S2S3	G4		
Fish	Percina phoxocephala	Slenderhead Darter	S1	G5		
Fish	Percina shumardi	River Darter	S1	G5		
Fish	Phenacobius mirabilis	Suckermouth Minnow	S3	G5		
Fish	Pimephales vigilax	Bullhead Minnow	S2	G5		
Fish	Polyodon spathula	Paddlefish	S1	G4		
Mammals	Lasiurus borealis	Eastern Red Bat	S4	G5	R	
Mammals	Lasiurus cinereus	Hoary Bat	S3	G5	—	
Mammals	Mustela nivalis	Least Weasel	S3	G5		
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2G3	T	
Mammals	Myotis sodalis	Indiana Bat	S1	G2	E	
Mammals	Synaptomys cooperi	Southern Bog Lemming	S3	G5		
Mammals	Zapus hudsonius	Meadow Jumping Mouse	S3	G5		
Mussels	Actinonaias ligamentina	Mucket	S3	G5		
Mussels	Amblema plicata	Threeridge	S3	G5		
Mussels	Anodontoides ferussacianus	Cylindrical Papershell	S2	G5		
Mussels	Ellipsaria lineolata	Butterfly	S2	G4		
Mussels	Elliptio crassidens	Elephant-ear	S2	G5		
Mussels	Elliptio dilatata	Spike	S3	G5		
Mussels	Fusconaia flava	Wabash Pigtoe	S1	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Mussels	Fusconaia subrotunda	Long-solid	S3	G3		At Risk-Cons
Mussels	Lampsilis cardium	Plain Pocketbook	S3	G5		
Mussels	Lampsilis fasciola	Wavy-rayed Lampmussel	S3	G5		
Mussels	Lampsilis ovata	Pocketbook	S3	G5		
Mussels	Lasmigona complanata	White Heelsplitter	S3	G5		
Mussels	Lasmigona costata	Fluted-shell	S3	G5		
Mussels	Leptodea fragilis	Fragile Papershell	S3	G5		
Mussels	Ligumia recta	Black Sandshell	S3	G5		
Mussels	Megalonaias nervosa	Washboard	S2	G5		
Mussels	Obliquaria reflexa	Threehorn Wartyback	S3	G5		
Mussels	Pleurobema cordatum	Ohio Pigtoe	S2	G4		
Mussels	Pleurobema sintoxia	Round Pigtoe	S2	G4G5		
Mussels	Ptychobranchus fasciolaris	Kidneyshell	S3	G4G5		
Mussels	Pyganodon grandis	Giant Floater	S3	G5		
Mussels	Quadrula cylindrica	Rabbitsfoot	SX	G3G4		
Mussels	Quadrula metanevra	Monkeyface	S2	G4		
Mussels	Quadrula quadrula	Mapleleaf	S3	G5		
Mussels	Simpsonaias ambigua	Salamander Mussel	S2	G3		
Mussels	Strophitus undulatus	Creeper	S3	G5		
Mussels	Tritogonia verrucosa	Pistolgrip	S3	G4G5		
Mussels	Truncilla donaciformis	Fawnsfoot	S1	G5		
Mussels	Truncilla truncata	Deertoe	S2	G5		
Mussels	Uniomerus tetralasmus	Pondhorn	S1	G5		
Mussels	Utterbackia imbecillis	Paper Pondshell	S2	G5		
Mussels	Villosa iris	Rainbow	S2	G5Q		
Plants	Anemone canadensis	Roundleaf Thimbleweed	S1	G5		
Plants	Baptisia australis var. australis	False Blue Indigo	S3	G5T3T4		
Plants	Carex hirtifolia	Pubescent Sedge	S3	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Plants	Carex laxiculmis var. copulata	Spreading Sedge	S2	G5T3T5		
Plants	Carex normalis	Greater Straw Sedge	S3	G5		
Plants	Carex pellita	Woolly Sedge	S2	G5		
Plants	Chenopodium standleyanum	Standley's Goosefoot	S2	G5		
Plants	Cyperus squarrosus	Awned Flatsedge	S3	G5		
Plants	Elymus trachycaulus ssp. trachycaulus	Slender Wild Rye	S2	G5T5		
Plants	Equisetum sylvaticum	Woodland Horsetail	S1	G5		
Plants	Hasteola suaveolens	False Indian-plantain	S3	G4		
Plants	Lechea minor	Thymeleaf Pinweed	S1	G5		
Plants	Peltandra virginica	Green Arrow-arum	S2	G5		
Plants	Potamogeton illinoensis	Illinois Pondweed	S2	G5		
Plants	Potamogeton pusillus var. tenuissimus	Slender Pondweed	S1	G5T5		
Plants	Potamogeton tennesseensis	Tennessee Pondweed	S2	G2		At Risk-Science
Plants	Prenanthes crepidinea	Corymbed Rattlesnake-root	S1	G4		
Plants	Prunus angustifolia var. angustifolia	Chickasaw Plum	S1	G5T4T5		
Plants	Ranunculus sceleratus var. sceleratus	Cursed Crowfoot	S2	G5T5		
Plants	Salix discolor	Pussy Willow	S2	G5		
Plants	Solidago patula var. patula	Roundleaf Goldenrod	S1	G5T5		
Plants	Synandra hispidula	Guyandotte Beauty	S1	G4		
Plants	Taxus canadensis	Canada Yew	S2S3	G5		
Plants	Thuja occidentalis	Northern White-cedar	S2	G5		
Plants	Trifolium stoloniferum	Running Buffalo Clover	S3	G3	E	
Plants	Vitis rupestris	Sand Grape	S2	G3		
Plants	Woodwardia areolata	Netted Chainfern	S2	G5		
Reptiles	Apalone spinifera spinifera	Eastern Spiny Softshell	S4	G5T5		
Reptiles	Liochlorophis vernalis	Smooth Greensnake	S5	G5		

Taxa	Scientific Name	Common Name	S Rank	G Rank	Federal Status	USFWS at Risk
Reptiles	Regina septemvittata	Queen Snake	S4	G5		
Reptiles	Terrapene carolina carolina	Eastern Box Turtle	S5	G5T5		
Snails	Anguispira kochi	Banded Tigersnail	S1	G5		
Snails	Catinella vermeta	Suboval Ambersnail	S3	G5		
Snails	Hawaiia alachuana	Southeastern Gem	S3	G4G5Q		
Snails	Inflectarius inflectus	Shagreen	S2	G5		
Snails	Mesodon mitchellianus	Sealed Globelet	S3	G4		
Snails	Stenotrema barbatum	Bristled Slitmouth	S3	G5		
Snails	Stenotrema simile	Bear Creek Slitmouth	S2	G2		
Snails	Striatura milium	Flat-ribbed Striate	S2	G5		

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

Federal Status: R = Rare, T= Threatened, E = Endangered.

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

Appendix 2. Priority SGCN, Known Stresses and Actions

Forest and Woodlands		
Common Name	**Local Stresses**	**Action**
Bald Eagle	• Lead poisoning	• Encourage usage of non-lead shot
Banded Tigersnail	• Habitat loss	• Maintain/restore river bluffs
Blue-winged Warbler	• Insufficient habitat. • Residential development	• Reduce clean farming practices. • Create early successional habitat
Broad-winged Hawk	• Poor forest structure	• Forest management for gaps
Bronze Copper	• Development. • Agricultural intensification. • Wetland loss	• Conservation and enhancement of open areas for pollinators
Cerulean Warbler	• Poor forest structure	• Manage forests to create suitable habitat as per CERW guidelines
Hoary Bat	• Urbanization, habitat degradation	• Documentation of wintering and breeding loctions/habitats along with migratory routes. • BMPs that allow for maintenance of large roosting trees and small openings within forested stands
Indiana Bat	• Agriculture, industry	• Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Kentucky Warbler	• Deer overherbivory. • Incompatible forest structure	• Manage deer population. • Manage forests for structural and spatial complexity

Forest and Woodlands		
Common Name	**Local Stresses**	**Action**
Northern Myotis	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Prairie Warbler	• Forest maturation. • Herbicide use/veg mgmt in utility corridors	• Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat
Running Buffalo Clover	• Woody encroachment	• Thin forest canopy. • Establish trails and encourage trail use through area.
Thymeleaf Pinweed	• Woody encroachment. • Unknown status	• Monitor population. Conduct surveys for additional sites.
Wood Thrush	• Deer overherbivory. • Incompatible forest structure. • Residential development	• Manage deer population. • Manage forests for structural and spatial complexity
Yellow-breasted Chat	• Forest maturation. • Herbicide use/veg mgmt in utility corridors	• Manage forests to create early successional habitat. • Manage utility corridors to maintain compatible habitat

Aquatic		
Common Name	**Local Stresses**	**Action**
American Eel	• Stream passage barriers	• Install Eel ladders
Eastern Hellbender	• Persecution by anglers. • Sedimentation. • Field herpers. • Habitat manipulation. • Disease	• 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
Eastern Spiny Softshell	• River channelization. • Sedimentation. • Recreation. • Artificial increase in mesocarnivores	• Identify important nesting beaches. • Reduce human recreation on sandy beaches. • Encourage trash clean-up to reduce mesopredators from 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
Paddlefish	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Create and/or preserve island, shoal and sandbar habitats. • Promote river/stream passage. • Promote river/flood plain interactions

Aquatic		
Common Name	**Local Stresses**	**Action**
Rabbitsfoot	• Sedmentation. • Hydarulic changes. • Water chemisty	• Sediment control. • Water withdrawal conservation. • Unconventional Oil & Gas BMP's
Rainbow Bluet	• Siltation of ponds at Tomlinson Run State Park	• Monitor ponds
Redside Dace	• Increasing stream temperatures. Increased stream sedimentation	• Restore riparian areas. Mitigate causes of sedimentation. • BMPs by resource extraction companies
River Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Riparian restoration
River Shiner	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Create and/or preserve island, shoal and sandbar habitats
Suckermouth Minnow	• Increased sedimentation. • Increased stream temperatures	• Riparian restoration
Tippecanoe Darter	• Increased sedimentation. • River channelization. • Point & nonpoint-source pollution	• Create and/or preserve island, shoal and sandbar habitats

Wetlands, Floodplains, Riparian Habitats		
Common Name	**Local Stresses**	**Action**
American Woodcock	• Insufficient habitat. • Residential development	• Reduce clean farming practices. • Create early successional habitat
Bald Eagle	• Lead poisoning	• Encourage usage of non-lead shot
Bank Swallow	• Habitat loss	• Locate breeding colonies and protect nest microhabitat

Wetlands, Floodplains, Riparian Habitats		
Common Name	**Local Stresses**	**Action**
Belted Kingfisher	• Poor water quality. • Insufficient nest microhabitat	• Identify important waterways and improve water quality
Corymbed Rattlesnake-root	• Unknown status	• Monitor populations (vegetative and flowering).
Eastern Spiny Softshell	• River channelization. • Sedimentation. • Recreation. • Artificial increase in mesocarnivores	• Identify important nesting beaches. • Reduce human recreation on sandy beaches. • Trash clean-up to reduce mesopredators from 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
Green Heron	• Human disturbance at breeding sites. • Degradation/loss of riparian habitats. • Poor water quality	• Conserve/improve riparian habitats. • Improve water quality
Green Heron	• Human disturbance at breeding sites. • Degradation/loss of riparian habitats. • Poor water quality	• Conserve/improve riparian habitats. Improve water quality
Hoary Bat	• Urbanization, habitat degradation	• Documentation of wintering and breeding locations/habitats along with migratory routes. • BMPs that allow for maintenance of large roosting trees and small openings within forested stands

Wetlands, Floodplains, Riparian Habitats		
Common Name	**Local Stresses**	**Action**
Indiana Bat	• Agriculture, industry	• Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Kentucky Warbler	• Deer overherbivory. • Incompatible forest structure	• Reduce deer population. • Manage forests for structural and spatial complexity
Louisiana Waterthrush	• Loss of riparian forests. • Stream degradation. • Acid deposition. • Residential development	• Improve water quality. • Conserve riparian and upland stream valley forests. • Conservation easements
Northern Myotis	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Running Buffalo Clover	• Woody encroachment	• Thin forest canopy. • Establish trails and encourage trail use through area.
Smoky Rubyspot	• Poor water quality. • Industrialization of river stream banks	• Improve/maintain water quality in Ohio and Kanawha Rivers
Tennessee Pondweed	• Unknown status	• Field survey to determine species distribution and threats.

Caves and Karst		
Common Name	**Local Stresses**	**Action**
Indiana Bat	• Agriculture, industry	• Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.
Northern Myotis	• Deforestation, agriculture, industry	• Follow Forestry BMPs developed by White-Nose Syndrome Response team. • Promote intact and healthy riparian corridors by reducing nonpoint pollution sources and through stream restoration projects.

Agricultural and Developed Habitats		
Common Name	**Local Stresses**	**Action**
American Kestrel	• Insufficient nest microhabitat. • Residential development	• Nest box installation and monitoring
American Woodcock	• Insufficient habitat. • Residential development	• Reduce clean farming practices. • Create early successional habitat
Bobolink	• Clean farming practices. • Nest failure from incompatible haying practices. • Residential development	• Adjust timing of hay harvest. • Reduce conversion of grasslands to croplands. • Conservation easements
Bronze Copper	• Development. • Agricultural intensification. • Wetland loss	• Conservation and enhancement of open areas for pollinators
Chimney Swift	• Chimney capping. • Turnover of older structures	• Landowner outreach and education. • Protect known significant migration roosts. • Uncap chimneys. Install swift towers

Agricultural and Developed Habitats		
Common Name	**Local Stresses**	**Action**
Eastern Meadowlark	• Clean farming practices. • Nest failure from incompatible haying practices. • Residential development	• Adjust timing of hay harvest. • Reduce conversion of grasslands to croplands. • Conservation easements
Field Sparrow	• Insufficient habitat. • Clean farming practices. • Residential development	• Retain or plant shrubs in field and hedgerows. • Create early successional habitat
Grasshopper Sparrow	• Clean farming practices. • Nest failure from incompatible haying practices. • Residential development	• Adjust timing of hay harvest. • Reduce conversion of grasslands to croplands. • Conservation easements
Henslow's Sparrow	• Conversion of hay fields to croplands. • Incompatible haying practices. • Forest succession	• Adjust timing of hay harvest. • Reduce conversion of grasslands to croplands. Conservation easements

Appendix 3. Habitats on Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat

Bear Rocks Lake Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Mixed Mesophytic Forests
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Cool

Burches Run Wildlife Management Area	• **Forest and Woodland**
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Low Gradient, Warm
		• Headwater Creek, Moderate Gradient, Warm
		• Headwater Creek, High Gradient, Cool

Castlemans Run Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	  • Northern Hardwood Forests
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • River Floodplains
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Low Gradient, Warm
		• Headwater Creek, Moderate Gradient, Cool
		• Small River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat

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

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

Hillcrest Wildlife Management Area	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	  • Northern Hardwood Forests
	• **Aquatic, Floodplain and Riparian**
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Moderate Gradient, Cool
		• Headwater Creek, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat

Tomlison Run State Park	• **Forest and Woodland**
	  • Anthropogenic Shrubland & Grassland
	  • Dry-Mesic Oak Forests
	  • Dry Oak (Pine) Forests
	  • Mixed Mesophytic Forests
	• **Aquatic, Floodplain and Riparian**
	  • Open Water
	  • Small Stream Riparian Habitats
	• **Agricultural and Developed**
	  • Agriculture
	  • Developed
		• Headwater Creek, Low Gradient, Warm
		• Headwater Creek, Moderate Gradient, Cool
		• Headwater Creek, High Gradient, Cool

Appendix 4. Impaired Streams

Reach Code	AUID	Common Name	Impairments
05030101001778	WVO-97-B_02	AlexandersRun	Bio, Fecal
05030101001778	WVO-97-B_01	AlexandersRun	Bio ,Fecal ,Iron
05030101004760	WVO-95.5_00	AlleghanySteelRun	Bio ,Fecal
05030106001435	WVO-88-D-8_00	BattleRun	Fecal ,Iron
05030106001421	WVO-88-D-2-F-(L1)_00	BearRockLake#1	DO, Sedimentat, Trophic_St
05030106001421	WVO-88-D-2-F-(L2)_00	BearRockLake#2	Chlorophyll, Phosphorus
05030101001852	WVO-95-A_00	BosleyRun	Bio, Fecal
05030101001777	WVO-97-D_00	BrownHollow	Bio, Fecal
05030106000271	WVO-92_00	BuffaloCreek	Bio
05030106001126	WVO-92-L_02	CastlemanRun	Fecal
05030106001121	WVO-92-L_01	CastlemanRun	Bio, Fecal
05030106008132	WVO-92-L-(L1)_00	CastlemanRunLake	Chlorophyll, Phosphorus, Sedimentat, Trophic_St
05030101001783	WVO-95_01	CrossCreek	Fecal
05030101001785	WVO-95_02	CrossCreek	Bio, Fecal
05030101001714	WVO-101_01	DeepGutRun	Bio, pH, Aluminum, Iron
05030101001714	WVO-101_03	DeepGutRun	Bio
05030101001714	WVO-101_02	DeepGutRun	Bio, Aluminum, Iron
05030106000158	WVO-88-N-(L1)_00	DunkardForkLake	Phosphorus
05030106000181	WVO-88-O_00	EnlowFork	Fecal
05030106001242	WVO-90-A_02	GirtyRun	Bio, Fecal, Iron
05030106001241	WVO-90-A_01	GirtyRun	Bio, Fecal
05030106001247	WVO-89_00	GlennsRun	Bio, pH, Aluminum, Iron, Manganese
05030106001248	WVO-89-A_00	GraebHollow	Bio, Iron
05030101000425	WVO-97_02	HarmonCreek	Bio, Fecal
05030101000425	WVO-97_01	HarmonCreek	Fecal
05030101001724	WVO-99_00	HolbertRun	Iron
05030106004319	WVO-90-D-1_00	HuffRun	Bio, Fecal, Chloride
05030101000443	WVO-98_01	KingsCreek	Bio, Fecal
05030101000444	WVO-98_02	KingsCreek	Fecal
05030106001408	WVO-88-D-2-D_00	LaidleyRun	Fecal
05030106000241	WVO-88-D_00	LittleWheelingCreek	Fecal, Iron
05030106004347	WVO-88-B_00	LongRun	Bio, Fecal, Iron
05030106001129	WVO-92-L-1_00	LongsRun	Fecal
05030101001780	WVO-96_00	MahanRun	Bio, Fecal
05030101003192	WVO-108_00	MarksRun	Bio, Fecal
05030101004238	WVO-98-A.5_00	MarrowRun	Bio, Fecal
05030106001439	WVO-88-D-3_00	McCoyRun	Fecal, Iron
05030106000666	WVO-88-D-9_00	McGrawRun	Fecal
05030101001764	WVO-97-C_00	MechlingRun	Fecal
05030101001701	WVO-102-C-1_00	MercerRun	Bio, Fecal
05030101001680	WVO-107_01	MiddleRun	Bio, Fecal
05030106000221	WVO-88-D-2_00	MiddleWheelingCreek	Fecal, Iron
05030106000668	WVO-92-G_00	MingoRun	Fecal

Reach Code	AUID	Common Name	Impairments
05030101001682	WVO-105_00	MuchmoresRun(LaurelHollow)	Bio, Fecal
05030101001752	WVO-98-A_00	NorthFork/KingsCreek	Fecal
05030106001231	WVO-90-D_00	NorthFork/ShortCreek	Bio, Fecal, Chloride
05030101001697	WVO-102-C_00	NorthFork/TomlinsonRun	Bio, Fecal
05030101001850	WVO-95-C_00	NorthPotrockRun	Fecal
05030101000010	WVO-un_01	OhioRiver(uppernorth)	Dioxin, PCBs, Bacteria
05030101000012	WVO-un_02	OhioRiver(uppernorth)	Iron, Dioxin, PCBs, Bacteria
05030106002656	WVO-us_01	OhioRiver(UpperSouth)	Dioxin, PCBs, Bacteria
05030106002292	WVO-us_02	OhioRiver(UpperSouth)	Dioxin, PCBs, Bacteria
05030106001440	WVO-88-D-1_00	PetersRun	Bio, Fecal, Iron
05030106000676	WVO-92-D_00	PierceRun	Bio, Fecal, Iron
05030106004342	WVO-88-B-2_00	PogueRun	Bio, Fecal, Iron
05030106002595	WVO-88-D-5_00	PointRun	Bio, Fecal, Iron
05030101001802	WVO-95-D_00	PotrockRun	Bio, Fecal
05030106001132	WVO-92-L-4_00	RicesRun	Fecal
05030106001437	WVO-88-D-6_00	RoneysPointRun	Bio, Fecal, Iron
05030101004151	WVO-98-0.7A_00	RushRun	Bio, Fecal
05030101001763	WVO-97-A_00	SappingtonsRun	Bio, Fecal
05030106001227	WVO-90_00	ShortCreek	Bio, Fecal
05030101001704	WVO-102-B_00	SouthFork/TomlinsonRun	Bio, Fecal
05030106002320	WVO-90-B_00	SouttellRun	Iron
05030106000680	WVO-88-K_00	StullRun	Fecal
05030106001428	WVO-88-D-2-0.5A_00	TanyardRun	Fecal
05030106001421	WVO-88-D-2-F_00	ToddRun	Bio, FecalIron
05030101010897	WVO-102-(L1)_00	TomlinsonRunLake	Sedimentat
05030101001762	WVO-98-0.5A_00	TurkeyfootRun	Fecal
N/A	WVO-95.5-A_00	UMT/AlleghanySteelRunRM1.09	Bio, Fecal
05030106001993	WVO-92-E.1_00	UNT/BuffaloCreekRM5.18	Iron
05030101001853	WVO-95-0.5A_00	UNT/CrossCreekRM1.81	Fecal
05030106002434	WVO-89-B_00	UNT/GlennsRunRM1.38	Iron
05030101001779	WVO-97-0.7A_00	UNT/HarmonCreekRM2.95	Fecal
05030101004434	WVO-97-0.9A_00	UNT/HarmonCreekRM3.32	Fecal
05030101003968	WVO-99-B_00	UNT/HolbertRunRM1.26	Fecal
05030101004286	WVO-98-C_00	UNT/KingsCreekRM6.95	Fecal

Reach Code	AUID	Common Name	Impairments
05030106001432	WVO-88-D-15_00	UNT/LittleWheelingCreekRM8.97	Fecal
05030101004622	WVO-96-A_00	UNT/MahanRunRM2.04	Bio, Fecal
05030101003192	WVO-108-A_00	UNT/MarksRunRM0.89	Bio, Fecal
05030106001429	WVO-88-D-2-0.4A_00	UNT/MiddleWheelingCreekRM3.05	Fecal
05030106001239	WVO-90-D-0.8_00	UNT/NorthForkRM1.32/ShortCreek	Bio, Fecal
05030106001237	WVO-90-D-1.6_00	UNT/NorthForkRM2.55/ShortCreek	Fecal
05030106001236	WVO-90-D-1.8_00	UNT/NorthForkRM2.77/ShortCreek	Fecal
05030101001698	WVO-102-C-6_00	UNT/NorthForkRM4.48/TomlinsonRun	Fecal
05030101003166	WVO-104.7_00	UNT/OhioRiverMP46.14	Iron
05030106002089	WVO-91_00	UNT/OhioRiverMP79.4(HarrisonRun)	Bio, Fecal
05030106001219	WVO-92-D-6_00	UNT/PierceRunRM2.67	Fecal
05030106002356	WVO-90-H_00	UNT/ShortCreekRM6.03	Bio, Iron
05030106002556	WVO-88-B-1-A_00	UNT/WaddlesRunRM1.72	Iron
05030106003256	WVO-88-N-1-C_00	UNT/WhartonRunRM2.01	Iron
05030106001387	WVO-88-M.3_00	UNT/WheelingCreekRM25.77	Bio, Fecal, Chloride
05030106003044	WVO-88-M.35_00	UNT/WheelingCreekRM26.23	Fecal
05030106001386	WVO-88-M.4_00	UNT/WheelingCreekRM26.55	Fecal
05030106001448	WVO-88-B-1_00	WaddlesRun	Bio, Fecal, Iron
05030106001234	WVO-90-D-2_00	WeidmanRun	Bio, Fecal
05030106000136	WVO-88_00	WheelingCreek	Fecal

Appendix 5. Partners and Assistance Provided

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

Partner	Role/Assistance Provided
American Forest Foundation (AFF) https://www.forestfoundation.org/ https://www.familyforestcarbon.org/	• The American Forest Foundation's mission is to deliver meaningful conservation impact through the empowerment of family forest landowners. • The American Tree Farm System (ATFS) recognizes landowners for their good stewardship and adhering to the ATFS Standards of Sustainability while meeting their own goals and objectives for their land. • The Family Forest Carbon Program focuses on two specific practices: Growing Mature Forests (encouraging Forest Management Plans) and Enhancing the Future Forest (control of competing vegetation to improve regeneration before or after a regeneration harvest)
Appalachian Mountains Joint Venture https://amjv.org/	• The Appalachian Mountains Joint Venture (AMJV) is a regional partnership of state and federal agencies, conservation organizations and universities who work to restore and sustain viable populations of native birds and their habitats in the Appalachian Mountains. AMJV works with partners to provide private landowners with guidance and opportunities to improve habitat for birds and other wildlife.
Cave Conservancy of the Virginias (CCV) https://caveconservancyofvirginia.org/	• Promoting conservation, management, knowledge and acquisition of caves and karst resources in Virginia and West Virginia • Contributes to educational, research and environmental protection projects • Funds a variety of cave and karst education, outreach, research, cleanup and acquisition projects. • Provides research scholarships and stipends for graduate and undergraduate students • Supports *Project Underground* environmental education program to promote a better understand of caves and karst lands. Training interested people in the fundamentals of natural history, nature interpretation and teaching.
Consulting Foresters https://wvforestry.com/forestry-consultants/	• Developing Forest Stewardship Plans • Promoting Forestry BMPs • Designing forest management practices to achieve landowner goals and ecological objectives • Assisting landowners with developing forest carbon projects aimed at achieving verifiable carbon sequestration through improved forest management practices

Partner	Role/Assistance Provided
Forest Certification Programs: • American Tree Farm System (ATFS) https://www.treefarmsystem.org/ • Sustainable Forestry Initiative (SFI) https://www.forests.org/ https://www.wvfa.org/sfi/ • Forest Stewardship Council (FSC) https://fsc.org/en	• Resources, assistance and certification for sustainable forest management on public and private lands
Grow Ohio Valley https://www.growov.org/	• Goal is to improve the health and the economic future of our region. A robust and sustainable local food system, built by and for the community, can impact both of these areas.
Master Naturalists Program Ohio Valley Chapter http://mnofwv.org/	• Training interested people in the fundamentals of natural history, nature interpretation and teaching. • Instilling an appreciation of the importance of responsible environmental stewardship. • Providing a corps of highly qualified volunteers to assist government agencies, schools and non-government organizations with research, outdoor recreation development, and environmental education and protection
National Speleological Society (NSS) and Standing Stone Grotto https://caves.org/	• Promotes safe and responsible caving practices, effective cave and karst management, speleology and conservation. • Members work together in NSS grottos (i.e, chapters), regions, surveys and sections to develop ideas and pursue projects in the areas of speleology, as well as cave conservation, management, preservation, restoration, exploration, surveying, rescue, equipment, techniques and education.
National Wild Turkey Federation (NWTF) https://www.nwtf.org/	• Provides information to landowners on hunting and habitat management for wild turkey and other wildlife • Partners with state and federal agencies on hunting access and habitat management for wild turkey and other wildlife species

Partner	Role/Assistance Provided
Ohio River Basin Alliance (ORBA) https://www.lrh.usace.army.mil/Missions/Civil-Works/ORBA/ORBA2/	• ORBA is a voluntary collaborative that provides a forum for addressing water resource issues in the Ohio River Basin in today's changing environment. • Executed as a US Army Corps of Engineers Planning Assistance to States (PAS) initiative, with ORSANCO as the fiscal sponsor and members from over 130 organizations including local, state and federal agencies, as well as commissions, industry, academia, and not-for-profit organizations. • To guide its working groups and objectives, the Plan for the Ohio River Basin 2020-2025 identifies basin-wide goals including abundant clean water, healthy and productive ecosystems, knowledge and education inform decisions, dependable commercial navigation, reliable flood risk management, and world-class nature-based recreation opportunities.
Ohio River Valley Water Sanitation Commission (ORSANCO) http://www.orsanco.org/	• Since 1948, ORSANCO and its member states have cooperated to improve water quality in the Ohio River Basin, ensuring the river can be used for drinking, industrial supplies and recreational purposes; and can support a healthy and diverse aquatic community. ORSANCO operates monitoring programs to check for pollutants and toxins that may interfere with specific uses of the river.
Outdoor Heritage Conservation Fund (OHCF) https://commerce.wv.gov/boards-commissions/outdoor-heritage-conservation-fund/	• The Outdoor Heritage Conservation Fund (OHCF) protects lands that host West Virginia's wild and wonderful natural resources. The OHCF's land-protection projects can include important wildlife habitats, working forests and farmlands, as well as hunting, fishing, and outdoor recreational areas. The OHCF is working to protect the best of our natural resources for all West Virginians.
Ruffed Grouse Society/American Woodcock Society (RGS) https://ruffedgrousesociety.org/#	• Creates healthy forest habitat for the benefit of ruffed grouse, American woodcock and other forest wildlife • Works with landowners and government agencies to develop critical habitat using scientific management practices • RGS works with the forest product industry, including landowners, foresters, loggers, and forest product manufacturers, to scale up capacity building, investment and conservation benefits from working forests to the landscape scale. • https://ruffedgrousesociety.org/the-ruffed-grouse-society-model-of-working-forests/

Partner	Role/Assistance Provided
The Conservation Fund (TCF) https://www.conservationfund.org/where-we-work/west-virginia	• Works with public, private and nonprofit partners to protect America's legacy of land and water resources through land acquisition, sustainable community and economic development, and leadership training, emphasizing the integration of economic and environmental goals.
The Nature Conservancy (TNC) https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/	• Assist public land managers with land protection, management and restoration to maintain landscape resilience and connectivity • Assist private landowners with land protection and improved management, including conservation easements and forest carbon projects • Manages a network of nature preserves and conservation easements for conservation and recreation
Trout Unlimited (TU) http://www.wvtu.org/ http://www.tu.org/	• Plans and implements restoration projects with landowners and in coordination with USFWS Partners program and USDA Natural Resource Conservation Service and Forest Service and other partners • Projects focus on riparian corridor and in-stream habitat restoration, invasive weed treatment and aquatic passage barrier removal/replacement to benefit brook trout and other wildlife species
US Army Corps of Engineers (USACE): Great Lakes and Ohio River Division https://www.lrd.usace.army.mil/ • Environmental Stewardship https://www.lrd.usace.army.mil/Missions/Environmental/ • Flood Risk Management: https://www.lrd.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/	• The Great Lakes and Ohio River Division civil works missions provide navigation, flood risk management, environmental, emergency response, recreation, hydropower, water supply and regulatory permits. • Through Environmental Stewardship, ACOE works to restore degraded ecosystem structure, function and dynamic processes to a more natural condition through large-scale ecosystem restoration projects • Flood risk management includes operation of dams, reservoirs and levees along the Ohio River and its tributaries

Partner	Role/Assistance Provided
US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program https://www.fws.gov/northeast/ecologicalservices/partners.html	• Provides technical and financial assistance to private landowners for restoration and enhancement of fish and wildlife habitat for the benefit of Federal Trust species (Migratory Birds, Threatened and Endangered and At-Risk Species) • Efforts focus on controlling nonnative invasive plants, managing livestock access to forests, wetland restoration, riparian buffer planting and fencing, in-stream habitat improvement, aquatic passage barrier removal and creating pollinator habitat • Works in coordination with the USDA Natural Resources Conservation Service farm bill programs, Trout Unlimited and other partners
USDA Farm Service Agency (FSA) https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP) • State Acres for Wildlife Enhancement (SAFE) • Farmable Wetlands Program (FWP) • Grasslands Reserve Program (GRP)	• CRP provides rental payments to agricultural producers participating voluntarily to safeguard environmentally sensitive land, conserve water quality, control soil erosion and enhance wildlife habitat, including floodplain wetlands. • CREP provides extra incentives and payments to eligible producers to reduce soil erosion and pollution, improve water quality and enhance terrestrial and aquatic wildlife habitat through practices such as riparian buffers and wetland restoration • The State Acres for Wildlife Enhancement (SAFE) Initiative provides farmers and landowners with assistance to establish wetlands, grasses and trees to enhance important wildlife populations by creating critical habitat and food sources, while protecting soil and water health. • The Farmable Wetlands Program (FWP) provides farmers and ranchers annual rental payments in return for restoration wetlands and wetland buffers zones. • The Grassland Reserve Program (GRP) provides farmers a rental payment to voluntarily prevent grazing and pasture land from being converted into cropland or urban development.

Partner	Role/Assistance Provided
USDA Natural Resources Conservation Service (NRCS): https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/programs/financial/ Environmental Quality Incentive Program (EQIP) • Conservation Stewardship Program (CSP) • Agricultural Management and Assistance Program (AMA) • Agricultural Conservation Easement Program (ACEP)	• 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.
West Virginia Association for Cave Studies (WVACS) https://www.wvacs.org/	• Contributes to cave surveys and research • Hosts cave scientists and graduate students pursuing cave research at field stations in Greenbrier County
West Virginia Cave Conservancy https://wvcc.net/	• Manages caves to protect sensitive cave resources and environments • Educates and provides expertise to landowners, developers, local governments and the public on the value of cave and karst resources • Organizes cave and karst conservation projects including sinkhole cleanups and livestock barrier fences. • Preserves access to significant caves through ownership and management agreements • Sponsor research and survey projects on WVCC caves

Partner	Role/Assistance Provided
West Virginia Land Trust (WVLT) https://www.wvlandtrust.org/	• WVLT's mission is to protect land with significant conservation values through the use of conservation easements and real estate acquisitions, and by working with a statewide network of partners to build a passionate land conservation movement in the state.
West Virginia University Extension Service (WVU Extension): • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife	• Landowner technical assistance and information on financial assistance for forest and wildlife management • Training workshops and conferences on forestry Best Management Practices and safety practices
WV Agricultural Land Protection Authority http://wvfp.org/	• Assisting landowners in preserving farmland through conservation easements.
WV Conservation Agency (WVCA) and Northern Panhandle Conservation District http://www.wvca.us • Ag Enhancement Program (AgEP) • Non-Point Source Program • Stream Partners Program	• The Ag Enhancement Program (AgEP), administered by Conservation Districts and the WVCA, offers technical and financial assistance to implement conservation best management practices for the reduction of nutrients and sediment entering waterways and increasing farm profitability and sustainability. Practices may include invasive species management and exclusion fencing to protect streams, wetlands and other environmentally sensitive areas. • Through Conservation Districts, the statewide Non-Point Source Program uses federal Clean Water Act, Section programs to reduce nonpoint source pollution related to agriculture, construction and urban stormwater management. • Through the Stream Partners Program, WVDNR, WVCA, WVDOF and WVDEP provide grants up to $5,000 to citizens' groups who want to improve, restore, protect, study or celebrate the state's rivers and streams.

Partner	Role/Assistance Provided
WV Department of Environmental Protection (WVDEP) • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx • Rehabilitation Environmental Action Plan (REAP) https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx • WVDEP Youth Environmental Program (YEP) https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx	• 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
WV Department of Health and Human Resources (WVDHHR) • On-Site Sewage Program https://www.wvdhhr.org/phs/sewage/index.asp	• Provides rule interpretation and technical assistance on conventional and non-conventional on-site sewage systems, including information on septic systems, installers, permits, fees and loan programs.
WV Division of Forestry (WVDOF) http://www.wvforestry.com/	• Oversees the Managed Timberland Program to provide tax incentives for landowners who manage their forest land sustainably according to a management plan • Oversee timber sales and Best Management Practices • Provides training workshops for loggers on safety and Best Management Practices • Maintains list of consulting foresters who can help landowners with Forest Stewardship Plans to enhance wildlife habitat • Protection of large private forest tracts through Forest Legacy Program
WV Division of Natural Resources (WVDNR) http://www.wvdnr.gov/	• Identification of SGCN and rare communities • Education, outreach and teaching resources • Field guides, Landscaping and Management guidelines • Fish and game management • Habitat restoration assistance • Natural Areas Program

Appendix 6. Resources

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

Long Range Plan for the Northern Panhandle Conservation District Summarizes local demographics, soils, food production, conservation education and historical practices, priority issues that strategies could be addressed through NRCS technical and financial assistance and partner support. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/eqip/?cid=nrcseprd1167606
Living on Karst- A Reference Guide for Landowners in Limestone Regions http://www.livingonkarst.org/living_on_karst.htm
Guidelines for Cave and Karst Protection- IUCN https://www.iucn.org/content/guidelines-cave-and-karst-protection-0
A Guide to Responsible Caving, by the National Speleological Society https://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf
National Wild Turkey Foundation- Landowner's Toolbox https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf-tool-box
Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf
Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners. https://www.allaboutbirds.org/bbimages/clo/pdf/GWWA-APPLRegionalGuide_130808_lo-res.pdf
Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors: https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf

West Virginia Pollinator Handbook – A Field Office Technical Guide Reference to management of pollinators and their habitats. Developed by WV NRCS Ecological Sciences in conjunction with WV Division of Natural Resources and the Xerces Society for Invertebrate Conservation. http://xerces.org/sites/default/files/publications/12-049.pdf
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The Nature Conservancy Resilient Land Mapping Tool and Documents: http://maps.tnc.org/resilientland/
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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
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