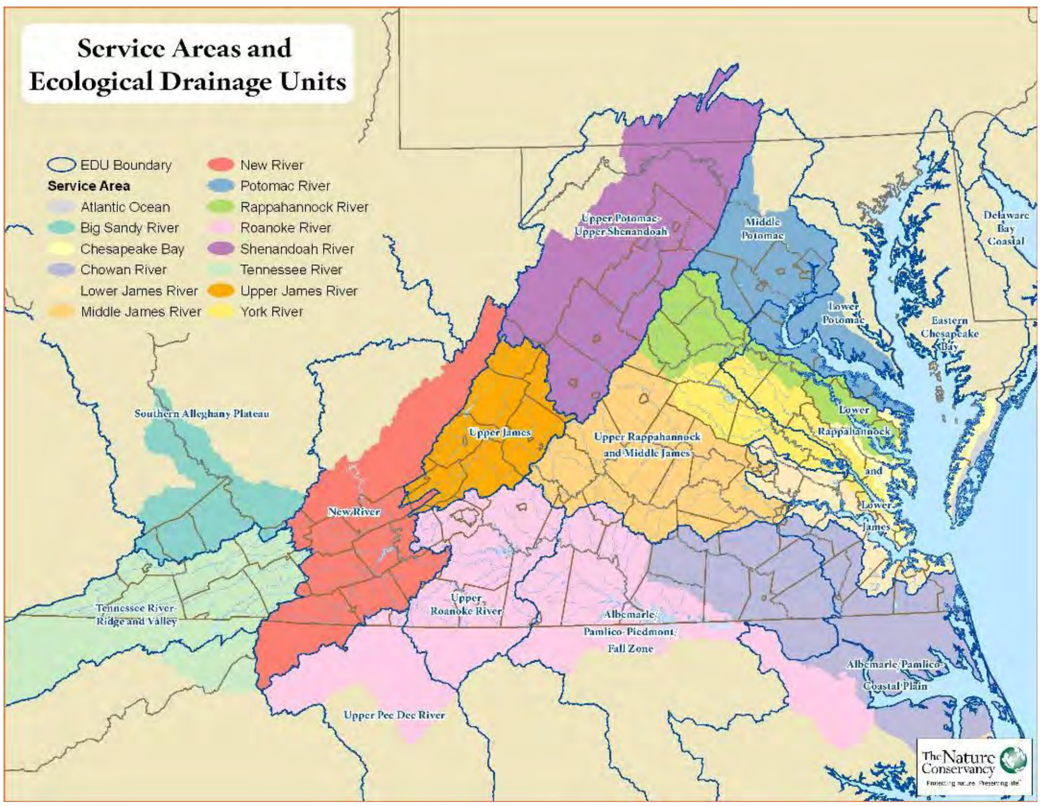
THE NATURE CONSERVANCY'S WATERSHED APPROACH TO COMPENSATION PLANNING FOR THE VIRGINIA AQUATIC RESTORATION TRUST FUND



December 2009

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APPENDIX A. ECOREGIONAL ASSESSMENT METHODS FOR AQUATIC, FOREST, NATURAL COMMUNITIES AND SPECIES CONSERVATION TARGETS

APPENDIX B. OPEN STANDARDS FOR THE PRACTICE OF CONSERVATION (A.K.A. CONSERVATION ACTION PLANNING)

PART ONE: THE NATURE CONSERVANCY'S CONSERVATION BY DESIGN

BACKGROUND

The Virginia Aquatic Resources Trust Fund (VARTF) is an in-lieu fee compensatory mitigation fund administered in partnership by The Nature Conservancy (TNC) and the Norfolk District United States Army Corps of Engineers (ACOE). The VARTF provides an alternate option for a permit applicant to address compensatory mitigation requirements associated with Section 404 and 401/Virginia Water Protection permits issued by the Corps and the Virginia Department of Environmental Quality (DEQ), respectively. By consolidating the mitigation requirements of multiple small projects, the TNC is able to use the VARTF to implement large-scale watershed efforts that restore, enhance, and protect water quality.

Recently, the EPA created a new rule to regulate in-lieu fee programs such as the VARTF which requires —compensation planning framework" be used for selecting and permitting mitigation projects funded through the VARTF. The rule states the following: —The approved instrument for an in-lieu fee program must include a compensation planning framework that will be used to select, secure, and implement aquatic resource restoration, establishment, enhancement, and/or preservation activities. The compensation planning framework must support a watershed approach to compensatory mitigation."

The required compensation framework must include the following ten elements:

- I. The geographic service area(s), including a watershed-based rationale for the delineation of each service area;
- II. A description of the threats to aquatic resources in the service area(s), including how the in-lieu fee program will help offset impacts resulting from those threats;
- III. An analysis of historic aquatic resource loss in the service area(s);
- IV. An analysis of current aquatic resource conditions in the service area(s), supported by an appropriate level of field documentation;
- V. A statement of aquatic resource goals and objectives for each service area, including a description of the general amounts, types and locations of aquatic resources the program will seek to provide;
- VI. A prioritization strategy for selecting and implementing compensatory mitigation activities;
- VII. An explanation of how any preservation objectives identified in element V and addressed in the prioritization strategy in element VI satisfy the criteria for use of preservation in section 332.3(h);
- VIII. A description of any public and private stakeholder involvement in plan development and implementation, including, where appropriate, coordination with federal, state, tribal and local aquatic resource management and regulatory authorities;
- IX. A description of the long-term protection and management strategies for activities conducted by the in-lieu fee program sponsor;

X. A strategy for periodic evaluation and reporting on the progress of the program in achieving the goals and objectives in element V of this section, including a process for revising the planning framework as necessary; and

XI. Any other information deemed necessary for effective compensation planning by the district engineer.

TNC's science-based conservation approach to setting goals and priorities, developing strategies, taking action and measuring results which we call —Conservation by Design" satisfies all of the requirements of the new compensatory mitigation rule for aquatic and wetland resources. The following document describes Conservation by Design and how it addresses the ten requirements of the new rule.

THE NATURE CONSERVANCY'S CONSERVATION BY DESIGN

The mission of The Nature Conservancy (TNC) is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. In order to fulfill this mission, TNC uses a collaborative, science-based conservation approach and a common set of analytical methods to identify the biodiversity that needs to be conserved, to decide where and how to conserve it and to measure our effectiveness. Together this conservation approach and set of analytical methods form the core of what we call Conservation by Design. The basic concepts of our conservation approach are simple and follow an adaptive management framework of setting goals and priorities, developing strategies, taking action and measuring results.

Conservation by Design Concept

Setting Priorities. To make the most effective progress toward our mission, we establish priorities which are those places that are most in need of conservation action or promise the greatest conservation return on our investment. We identify these priority places through conducting ecoregional assessments. An ecoregion is a large area of land or water that contains a geographically distinct assemblage of ecosystems and natural communities, and is differentiated by climate, subsurface geology, physiography, hydrology, soils, and vegetation. Through assessments of these ecoregions, TNC works with partners to develop data on the distribution and status of biodiversity, habitat condition, current and future threats and the socio-political conditions that influence conservation success within those ecoregions. These data allow us to set long-term conservation goals for ecosystems, natural communities and imperiled or declining species representative of an ecoregion, and to establish ecoregional priorities for resource allocation — specific landscapes, threats to biodiversity and strategic opportunities that affect one or more ecoregions and demand immediate attention. Ecoregional data also provide a baseline against which we can measure progress toward our mission at the level of the ecoregion, as well as toward the long-term goals for the representative ecosystems and species within an ecoregion.

Developing Strategies. We translate ecoregional priorities into conservation strategies and actions through Conservation Action Planning. This method is used to design and manage conservation projects that advance conservation at any scale — from efforts to conserve species and ecosystems in a single watershed or landscape, to efforts to reform regional or multi-national policies. Similar to ecoregional assessments, Conservation Action Planning is driven by data on the distribution and status of biodiversity, current and future threats and the socio-political conditions within the project area. These data are used to develop strategies and actions of sufficient scope and scale to abate threats, maintain or restore biodiversity and strengthen capacity to ensure long-term results. The data used in Conservation Action Planning also provide a baseline against which we can measure the effectiveness of our strategies and actions, gauge progress toward project objectives and adapt conservation strategies to changing circumstances.

Taking Action. The Nature Conservancy is committed to place-based results by taking action locally, regionally and globally, as called for by the strategies. The bulk of our resources--human and financial--are spent executing the strategies we develop together with partners. Our actions are varied and agile, but typically include investing in science to inform decision-making, protecting and managing land and water, forging strategic alliances with a variety of groups from all sectors, creating and maintaining supportive public policies, practices and incentives, strengthening the institutional capacity of governments and non-governmental organizations to achieve conservation results, developing and demonstrating innovative conservation approaches, building an ethic and support for biodiversity conservation, and generating private and public funding.

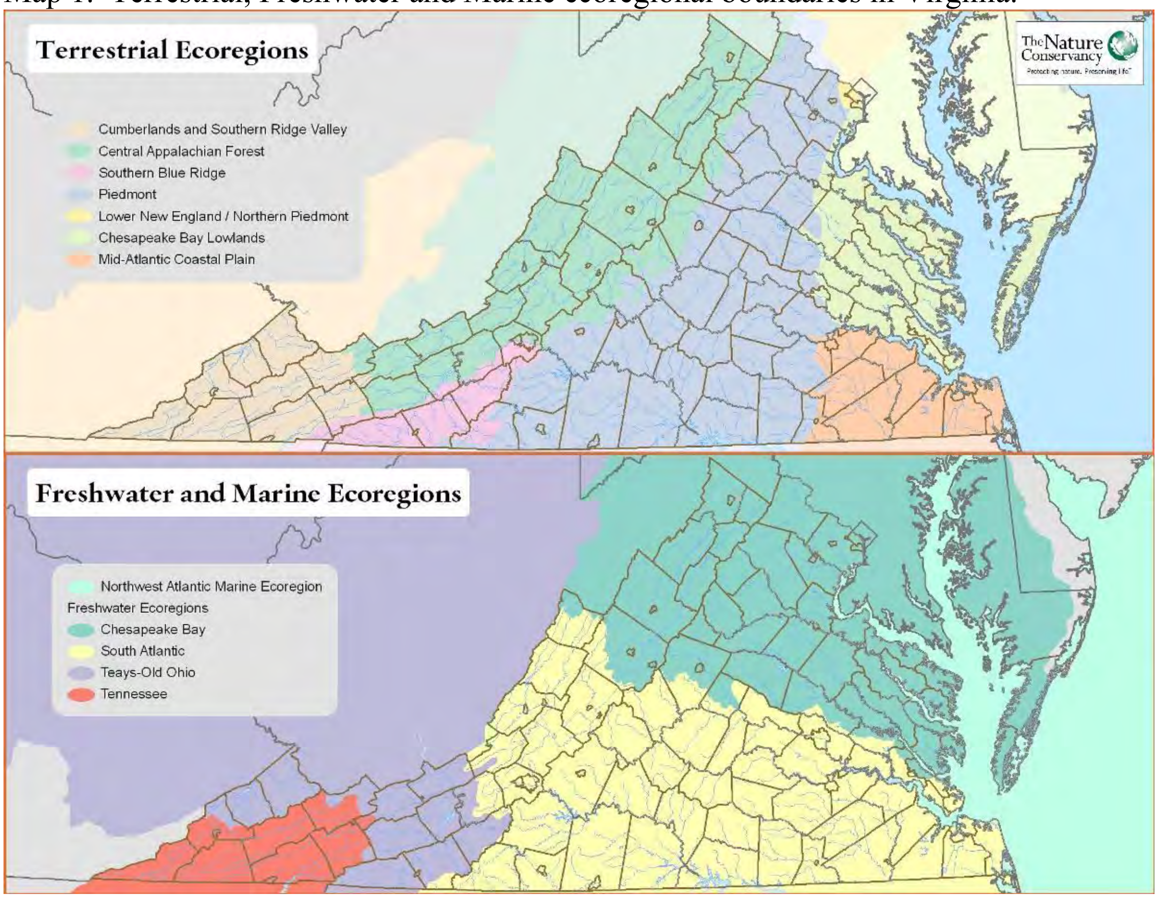
Measuring Results. We measure our effectiveness by answering two questions: ―How is the biodiversity doing?" and ―Are our actions having the intended impact?" The first question evaluates the status of species and ecosystems. The second question more specifically evaluates the effectiveness of our conservation strategies and actions. Tracking progress toward our goals and evaluating the effectiveness of our strategies and actions provide the feedback we need to adjust our goals, priorities and strategies and chart new directions.

ELEMENT I: GEOGRAPHIC SERVICE AREA DELINEATION

As described above, TNC uses ecoregions as to stratify biological diversity and select geographic priorities. We use terrestrial ecoregions as defined by Bailey and the USFS for identifying and prioritizing viable, representative and rare forested ecosystems, natural vegetation communities (including isolated wetlands), karst areas, and species occurrences; freshwater ecoregions for exemplary aquatic ecological systems, including streams and rivers, and rare aquatic species; marine ecoregions for marine ecological systems, habitats, species and communities (Map 1).

The freshwater ecoregions and their associated ecological drainage units best satisfy the new rule's requirement to delineate geographic service areas which are watershed based. Freshwater ecoregions used by TNC were developed by the World Wildlife Fund and are used as a standard large scale conservation planning unit for freshwater biodiversity. These watershed based units describe continental patterns of freshwater biodiversity on the scale of 100,000-200,000 sq. miles. The units are distinguished by patterns of native fish distribution that are the result of large-scale geoclimatic processes and

Map 1. Terrestrial, Freshwater and Marine ecoregional boundaries in Virginia.

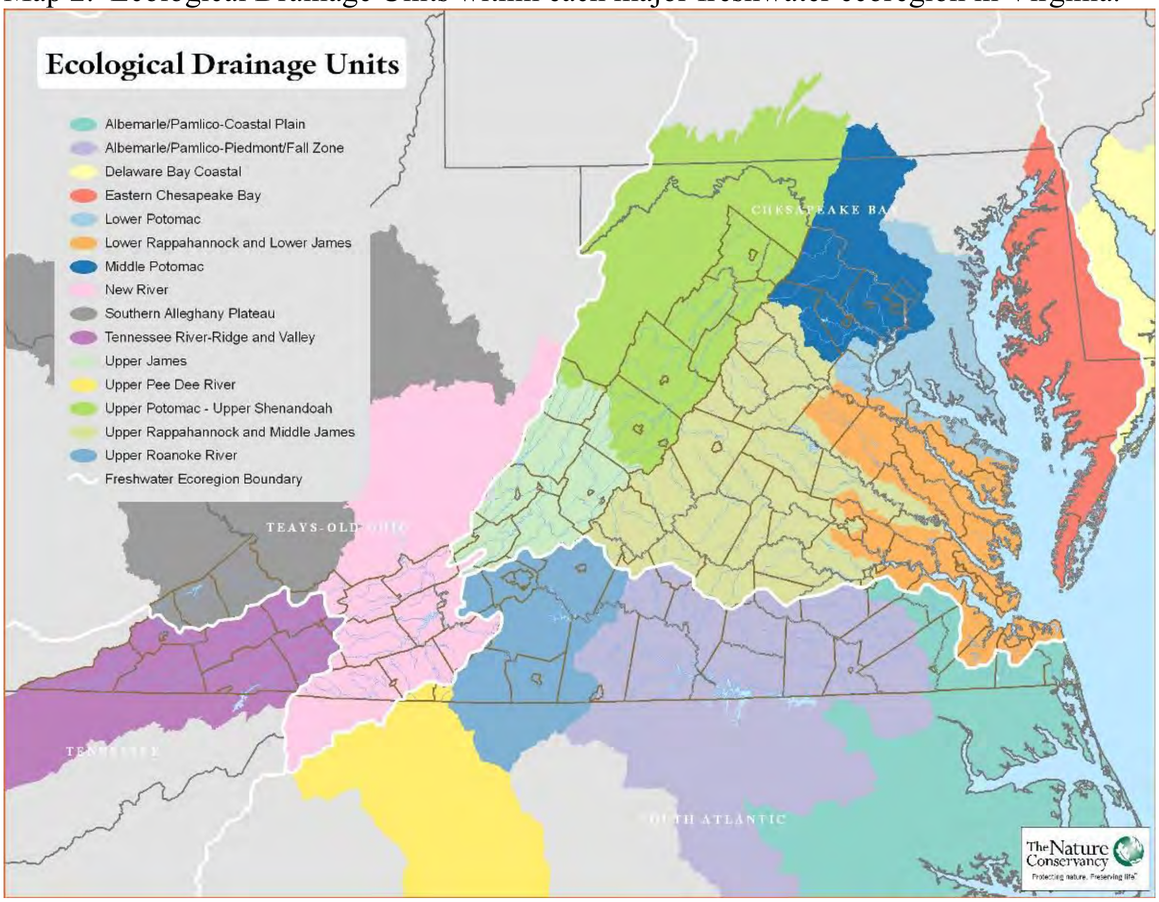


evolutionary history. Virginia contains portions of the upper Tennessee, upper Ohio, lower Chesapeake Bay, and North Atlantic freshwater ecoregions.

Within each freshwater ecoregion, aquatic ecologists at The Nature Conservancy have developed a further stratification level called ecological drainage units (EDUs) (Map 2). EDUs delineate areas within a freshwater ecoregion that correspond roughly with large watersheds ranging from 3,000–10,000 square miles. EDUs are likely to have a distinct set of freshwater assemblages and habitats associated with them. TNC aquatic biologists and hydrologist developed EDUs by aggregating the watersheds of major tributaries (8 digit HUCs) that share a common zoogeographic history as well as local physiographic and climatic characteristics, taking into consideration USFS Fish Zoogeographic Subregions, USFS Ecoregions and Subsections, and major drainage divisions.

Likewise, the geographic service areas of the VARTF are based on aggregations of major watersheds (8-digit HUCs) in Virginia. For the most part these are similar to the EDUs (Table 1). Discrepancies exist where service areas are split into separate EDUs along the Piedmont/Coastal Plain boundary (e.g. Chowan River service area split into Albemarle-Pamlico Piedmont/Fall Zone EDU and Albemarle-Pamlico Coastal Plain) and in lumping ecologically similar Piedmont watersheds a single EDU (e.g. Upper

Map 2. Ecological Drainage Units within each major freshwater ecoregion in Virginia.



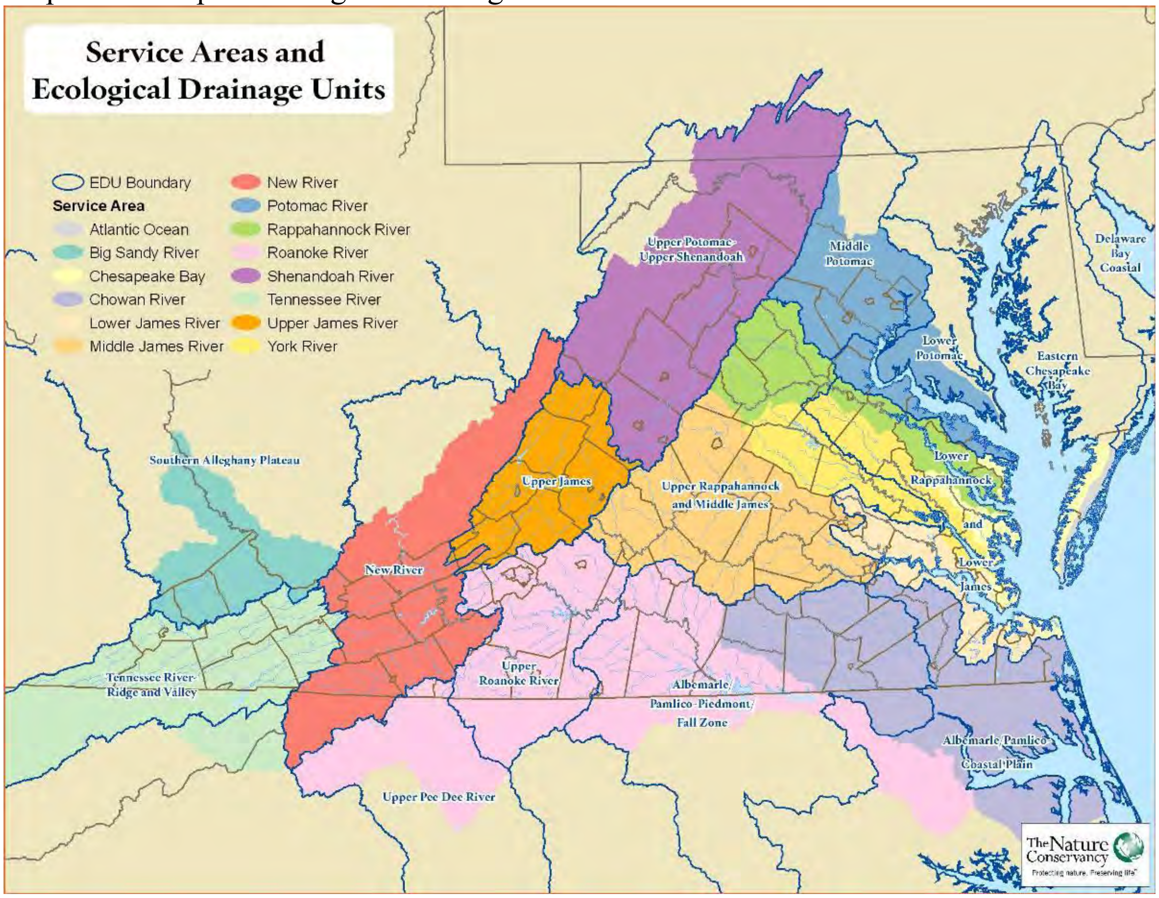
Rapphannock/Middle James EDU combines the Middle James, upper portion of the York and upper portion of Rappahannock service areas) (Map 3). In conclusion, while the aggregation of the 8-digit HUCS has some modifications for the purposes of the freshwater ecoregional assessment, TNC is using a clear watershed approach to planning and prioritizing aquatic resources and associated wetlands in Virginia.

Table 1. Crosswalk of Virginia DEQ/VARTF service areas and TNC ecological drainage units used for freshwater ecoregional assessments in Virginia.

Virginia DEQ/VARTF Service Areas	**TNC Ecological Drainage Units in Virginia**	**Differences**
Upper Tennessee River	Upper Tennessee River	None

Virginia DEQ/VARTF Service Areas	TNC Ecological Drainage Units in Virginia	Differences
Big Sandy River	Southern Alleghany Plateau	Big Sandy River included in the larger Southern Alleghany Plateau EDU
New River	New River	None
Upper James River	Upper James River	None
Roanoke River	Upper Roanoke River and Albemarle/Pamlico-Piedmont/Fall Zone	Roanoke River includes the upper Roanoke EDU and the portion of the Albemarle-Pamlico-Piedmont/Fall Zone EDU which falls in the Roanoke basin.
Shenandoah River	Upper Potomac-Upper Shenandoah	None
Potomac River	Middle Potomac and Lower Potomac	Potomac River is divided into two EDUs: Middle and Lower Potomac
Rappahannock River	Upper Rappahannock/ Middle James and Lower Rappahannock/Lower James	Rappahannock River is split between two EDUs: Upper Rappahannock/ Middle James and Lower Rappahannock/Lower James
York River	Upper Rappahannock/ Middle James and Lower Rappahannock/Lower James	York River is split between two EDUs: Upper Rappahannock/ Middle James and Lower Rappahannock/Lower James
Middle James	Upper Rappahannock/ Middle James	Upper Rappahannock/ Middle James EDU includes the entirety of the Middle James service area as well as the upper Rappahannock and upper York watersheds.
Chesapeake Bay	Lower Rappahannock/Lower James and Eastern Chesapeake Bay	Lower Rappahannock/ Lower James EDU includes the entire Chesapeake Bay service area as well the lower portions of the Rappahannock, York and James watersheds. The Eastern Chesapeake Bay EDU includes the eastern part of the service area in addition to most of the Delmarva Peninsula.
Atlantic Ocean	Eastern Chesapeake Bay	Eastern Chesapeake Bay EDU includes the Atlantic Ocean service area as well as the Delmarva Peninsula.
Chowan River	Albemarle/ Pamlico-Piedmont/ Fall Zone and Albemarle/ Pamilico-Coastal Plain	The Chowan service area is divided into two EDUs: Albemarle/Pamlico Piedmont/Fallzone and Coastal Plain

Map 3. Overlap of Ecological Drainage Unit Boundaries with VARTF Service Areas.



ELEMENTS II, III AND IV: THREATS ASSESSMENT

(includes description of the threats to aquatic resources in the service area(s), an analysis of historic resources lost in the service area(s), and an analysis of current resources lost in the service area(s))

TNC refers to priority ecosystems, communities, and species as “conservation targets”. These conservation targets serve as the basis for all our conservation actions and investments. The process used to define and select conservation targets for freshwater and terrestrial ecoregions is described in Appendix A. Through an ecoregional assessment, we evaluate the viability or biological integrity of each conservation target occurrence, considering both the current condition and the impact of historical threats. This viability assessment enables us to determine the best available examples of biodiversity in an ecoregion. Moreover, a thorough understanding of target viability further enables investment in areas where populations and ecosystems can function in light of current and imminent threats and allows practitioners to determine the need for conservation or restoration actions. Understanding the patterns of viability are central to measuring status and progress of effective conservation, informing conservation strategies, and as indicators of the impact of conservation actions.

The guiding criteria for assessing viability or biological integrity are as follows:

- **Size:** The abundance/density of a population, the area of a population or ecological system, or the length of linear connectivity of aquatic systems.
- **Condition:** The quality of biotic and abiotic factors, structures and processes within a population or ecological system occurrence, such as age structure, species composition, ecological processes and physical/chemical factors, degree of alteration due to anthropogenic impacts, and presence of biological legacies.
- **Landscape context:** The quality of structures, processes and biotic/abiotic factors of the landscape surrounding a population or ecological system, including degrees of connectivity and isolation to adjacent habitats, populations and ecological systems.

Detailed approaches to evaluating viability of conservation targets are described in Appendix A for forest ecosystems, aquatic ecological systems and species and communities, respectively.

In order to evaluate the size, condition and landscape context of each target occurrence, we use a combination of existing field data, geospatial data and analysis, and expert opinion to —screen” each occurrence. For example, in evaluating aquatic ecological systems, we compiled spatially explicit data on land cover, impervious cover, roads, dams, managed and conservation lands, and point source pollution. In addition, we used Virginia specific data including:

- VCU INSTAR database (data represent fish and macroinvertebrate assemblages, instream habitat, and stream health assessment, based on integrative, multimetric indices at the watershed scale and a stream reach scale)
- DEQ 303d waters list
- DEQ biological monitoring data, including EPT indices, species richness and indices of biological integrity
- Department of Game and Inland Fisheries (DGIF) threatened and endangered waters data
- DGIF aquatic species inventory data
- Department of Conservation and Recreation (DCR) Division of Natural Heritage (DNH) aquatic species inventory data

Each of these layers was used to do an initial assessment of the condition of the aquatic systems to determine the obviously in tact, high quality systems from the highly degraded ones.

To do a more detailed viability assessment, TNC works closely with experts and partners who are familiar with the ecoregion, holding workshops to solicit their input on the viability of these systems based on their field experience and data. For the freshwater ecoregional assessment, we interviewed aquatic resource managers and academics about local conditions for each system which could not be modeled using GIS data such as stocking, channelization, invasive species, non-point pollution, dam operation, and local water withdrawals. The outcome of these workshops was detailed information on the viability and threats to specific systems, including site-specific information on rare and endemic freshwater species and overall data gaps regarding the biology of these systems.

Viability of conservation targets is evaluated more carefully and thoroughly at individual priority conservation areas during the conservation action planning process. For each of the size, condition and landscape categories, key ecological attributes and indicators are developed for each target. A key ecological attribute is an aspect of a target's biology or ecology that if present, defines a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time. For example, a key attribute for a freshwater stream target might be some aspect of water chemistry. If the water chemistry becomes sufficiently degraded, then the stream target is no longer viable. Indicators are used to measure the status of key ecological attributes. For example, indicators for water quality would be pH, dissolved oxygen, or total suspended solids. An acceptable range of variation is defined for each indicator, describing the thresholds which constitute the minimum conditions for persistence of the target. Once the acceptable range of variation is established, a viability rating scale can then be developed using the following definitions:

- **Very Good** – Ecologically desirable status; requires little intervention for maintenance.
- **Good** – Indicator within acceptable range of variation; some intervention required for maintenance.
- **Fair** – Outside acceptable range of variation; requires human intervention.
- **Poor** – Restoration increasingly difficult; may result in extirpation of target.

In addition to rating the current condition of a target's viability, we also set goals for the desired future condition (moving a target from “fair” to “good” status). Assessing historical impacts and conditions is an important part of ranking viability and setting restoration goals. More information on viability assessment in conservation action plans can be found in Appendix B.

In addition, threats to conservation targets are identified and prioritized during conservation action planning so that conservation actions can be directed where they are most needed. We define threats as proximate activities or processes that directly have caused, are causing or may cause stresses and thus the destruction, degradation and/or impairment of conservation targets. Stresses are defined as impaired aspects of conservation targets that result directly or indirectly from human activities (threats). Each stress is rated in terms of its likely scope and severity of impact on the target within the project planning horizon. Each threat is then rated in terms of its contribution and irreversibility and these ratings are combined to determine threat ratings. The project team ranks scope, severity, contribution and irreversibility for each stress/threat combination using “very high”, “high”, “medium” and “low”. This is done using the available data, GIS analysis and the best judgment of staff, partners and experts. The result is a robust identification and evaluation of the most critical threats to biodiversity at a particular conservation area. The process of evaluating threats in conservation action plans is described in detail in Appendix B.

ELEMENTS V AND VI: AQUATIC RESOURCE GOALS / OBJECTIVES AND A PRIORITIZATION STRATEGY

Setting conservation goals and selecting the best, most viable examples of conservation targets to fulfill these goals is primary purpose of ecoregional assessments. Detailed methods on goal setting as well as selecting and prioritizing conservation areas where targets occur for forests ecosystems, freshwater systems, and species/communities can be found in Appendix A. Below is a summary of how these methods meet the criteria of Elements V and VI of the new rule.

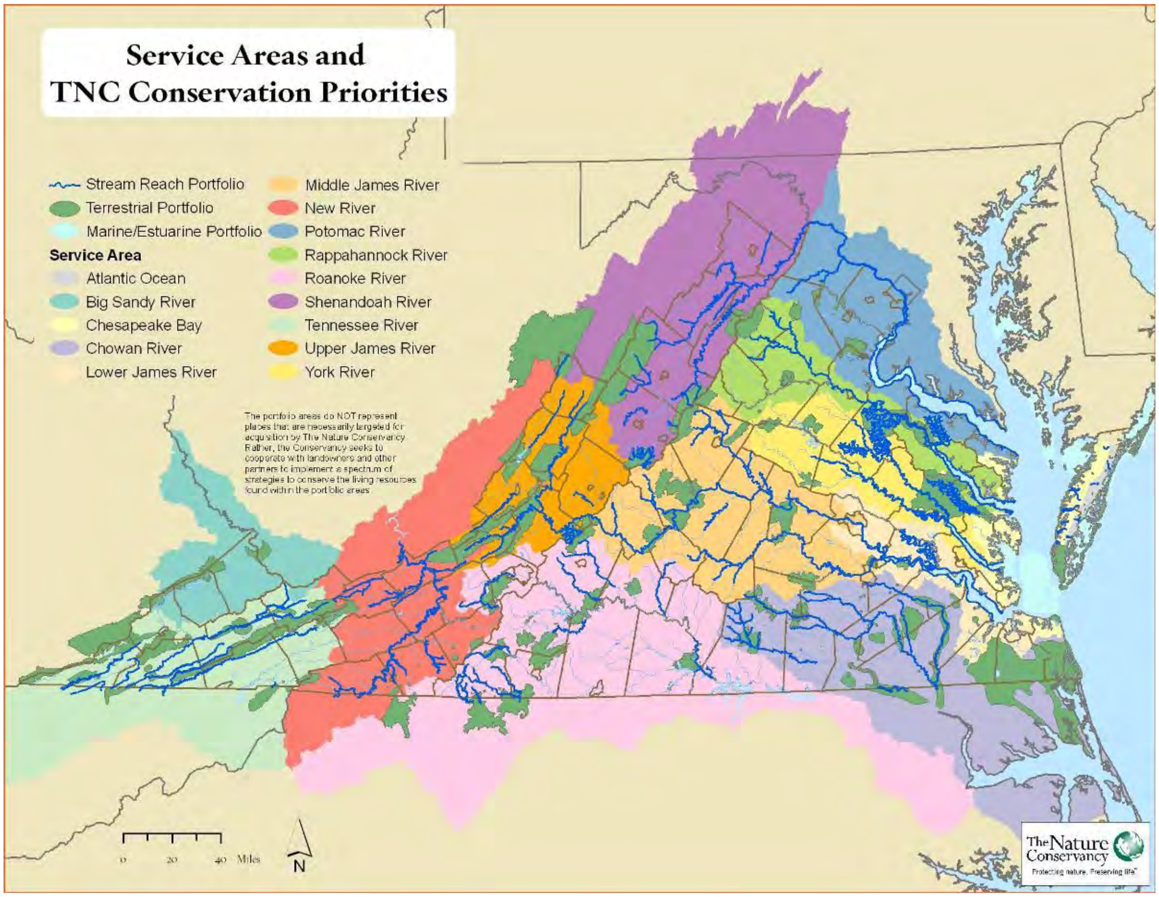
Conservation goals are the ecological criteria that we establish for the persistence and variability of conservation targets across an ecoregion. While viability criteria are applied for each target occurrence (e.g., size, condition landscape context), conservation goals define the abundance and spatial distribution of viable target occurrences necessary to adequately conserve those targets in an ecoregion for at least 100 years. Individual target goals contribute to development of a set of geographic priorities that depict characteristic landscape settings supporting all of the ecoregion's biodiversity.

Conservation goals in ecoregional planning have several components. Abundance goals are the number, or percent area of occurrences necessary for a target to persist. These goals provide redundancy. Distributional goals define how the target occurrences should be arrayed spatially across an ecoregion. These goals capture representation. Conservation of multiple, viable examples of each target, located across its geographic and ecological range addresses the ecological and genetic variability of the target, and provides sufficient redundancy and representation for persistence in the face of environmental stochasticity and human perturbations. Underlying these goals is a great deal of uncertainty since no scientific consensus exists on how much area or how many occurrences are necessary to conserve targets across their ranges and a lack of research to address representation goals for most species, communities, and ecological systems. Therefore, goals must be treated as working hypotheses and attributed with a level of uncertainty.

As an example, in the freshwater ecoregional assessments including Virginia, our conservation goal was to select at least one example of each medium and large river aquatic ecological system type within each EDU of good water quality (determined by condition variables described above) and one connected network of streams from headwaters to the coast or to a mainstem river per EDU.

Once we evaluate target viability and set conservation goals, the final step of an ecoregional assessment is to select a set of areas of biodiversity significance which most efficiently and effectively conserve the biodiversity of an ecoregion. These areas are collectively called a portfolio or a vision (Map 4). These areas are not conservation sites in the sense that they define the places where all strategies need to be implemented. Nor do not provide accurate boundaries for protected area design, or for maintaining corridors and functional landscapes. Rather, the portfolio captures places that contain the ecological systems, communities and species we want to effectively conserve, or priority conservation areas. Portfolios are designed to best achieve the conservation goals set for targets in the least number of places and areas of lands and waters. Current conservation

Map 4. TNC Ecoregional Conservation Priority Areas (aka Ecoregional Portfolio) overlaid on VARTF Service Areas.



and resource management practices, land ownership/management, and levels of threats are all considered when selecting geographic priorities for a portfolio.

In developing the freshwater ecoregional portfolios falling in Virginia, we used the assessment of current condition informed by a GIS analysis and expert workshops combined with our goals for representativeness and connectivity within each EDU to prioritize which aquatic ecological systems were included in the final portfolio for each ecoregion. We developed the following prioritization scheme for medium and large stream and river systems:

- **Tier 1:** Good to excellent example of a stream/river system type in terms of water quality and biological significance; attributed to indicate that system is part of a regional or intermediate scale connected stream network or not.
- **Tier 2**: Additional fair to good example of a stream/river system type, but in need of restoration to be viable; attributed to indicate that system is part of a regional or intermediate scale connected stream network or not.
- **Connector only**: Considered a priority because provides critical connection in stream network. However, these connectors usually are the lower mainstem reaches that are highly altered but needed for connectivity.

A considerable amount of professional judgment was exercised in categorizing aquatic systems as Tier 1, Tier 2 and Connector. In relatively intact landscapes where there were many high quality examples of each aquatic ecological system type, we included more than one instance of each watershed system in the conservation portfolio. In these cases, priorities for conservation action may depend on opportunity and imminence of threat. Conversely, in some degraded landscapes, there were few or no high quality examples of certain system types (Tier 1). In these areas, we recognize that restoration is necessary to elevate the condition of Tier 2 systems. However, it is important to also recognize that in almost every Tier 1 system, restoration actions are necessary to support preservation and protection efforts.

Details on ecoregional portfolio site selection vary for freshwater and terrestrial ecoregional assessments. Details on the selection method and criteria can be found in Appendix A.

ELEMENT XII. SATISFYING CRITERIA FOR USE OF PRESERVATION

The new rule requires that goal setting for and prioritization of aquatic resources as required by Elements v and vi above also satisfy the criteria for use of preservation. In the rule, preservation may be used to provide compensatory mitigation for activities when the following criteria are met:

> (i) The resources to be preserved provide important physical, chemical, or biological functions for the watershed;
> (ii) The resources to be preserved contribute significantly to the ecological sustainability of the watershed.

TNC's approach to setting ecoregional goals and the criteria used for selecting and prioritizing aquatic systems as well as forested ecosystems, estuarine sites, and occurrences of species and communities is designed with the explicit purpose of capturing critical environmental gradients, ecological processes, and genetic diversity to ensure the persistence and sustainability of viable biological diversity, ecological systems and functional landscapes in the ecoregion. Conservations actions are designed to abate threats and maintain and restore the viability, function and sustainability of these natural systems and diversity. The design principles discussed above and in Appendix A are wholly consistent with the criteria articulated in the new rule.

ELEMENT VIII. A DESCRIPTION OF ANY PUBLIC AND PRIVATE STAKEHOLDER INVOLVEMENT IN THE PLAN

TNC works closely with partners and experts to develop a conservation vision and set priorities through ecoregional assessments and to design and implement effective conservation strategies at multiple scales to realize our mission to conserve biological diversity. We depend on a wide diversity of partners from state and federal agencies, NGOs, industry, and academic institutions to inform and influence our work while providing the alliances necessary to achieve meaningful conservation results (Table 2). For example, the VARTF is an exemplary partnership including DEQ, ACOE, USFWS and TNC by which multiple conservation objectives are accomplished through collaborative action. Moreover, we have involved partners in all of our conservation action planning efforts to date in which we identify threats to conservation targets, develop measurable conservation objectives and design conservation actions to abate threats and restore viability to targets. Relying on the expertise of agency and academic scientists is crucial to the scientific credibility of our ecoregional portfolio and informing our conservation measures work. During the freshwater ecoregional assessments, freshwater experts in Virginia were consulted from Virginia Department of Game and Inland Fisheries, Virginia Department of Conservation and Recreation Division of Natural Heritage, Virginia Tech, US Fish and Wildlife Service, US Forest Service, Virginia Commonwealth University, and Virginia Department of Environmental Quality.

Table 2. Key partners for implementing conservation strategies in Virginia.

Federal Agencies
- Atlantic States Marine Fisheries Commission (ASMFC)
- Environmental Protection Agency (EPA)
- Department of Defense – U.S. Army, Fort A.P. Hill
- NASA
- National Oceanic and Atmospheric Administration (NOAA)
- National Park Service (NPS)
- Natural Resources Conservation Service (NRCS)
- U.S. Army Corps of Engineers (ACE)
- U.S. Department of Agriculture Forest Service (USDA-FS)
- U.S. Geological Survey (USGS)
- U.S. Naval Research Laboratory
- U.S. Fish and Wildlife Service (USFWS)

State Agencies
- Virginia Department of Conservation and Recreation (VDCR)—Division of State Parks, Division of Natural Heritage and Division of Soil and Water Conservation
- Virginia Department of Environment Quality (DEQ)
- DEQ-Coastal Resources Management (DEQ-CRM)
- Virginia Department of Game and Inland Fisheries (DGIF)
- Virginia Marine Resources Commission (VMRC)
- Virginia Department of Forestry (DOF)
- Virginia Department of Agriculture and Consumer Affairs (VDACS)
- Virginia Department of Mines, Minerals and Energy (DMME)
- Virginia Outdoors Foundation (VOF)

Local Government
- Soil and Water Conservation Districts
- Planning District Commissions
- County board of supervisors/city councils

Universities/Research Centers
- College of William and Mary, Center for Conservation Biology (CCB) and Virginia Institute for Marine Sciences (VIMS)
- Old Dominion University (ODU)
- University of Virginia (UVA), Long-Term Ecological Research center (LTER)
- Utah State University (USU)
- Virginia Commonwealth University (VCU)
- Virginia Tech

Industry
- Dominion
- Mead-Westvaco
- American Electric Power
- The Homestead
- Alpha Natural Resources

Non-Governmental Organizations
- Chesapeake Bay Foundation (CBF)
- National Wildlife Federation
- Southern Environmental Law Center
- Virginia United Land Trusts (VaULT) and its member organizations
- Virginia Conservation Network

ELEMENT IX. LONG-TERM PROTECTION AND MANAGEMENT STRATEGIES

TNC in Virginia is engaged in active implementation of a diversity of restoration and conservation strategies at multiple scales across the state and region to conserve biological diversity in priority conservation areas identified through ecoregional assessments. In addition to land protection, TNC works at state, regional and federal scales on funding and policy strategies necessary to abate threats at the scale at which they occur such as global climate change and acid deposition. Strategies are designed to abate a range of threats at the scales at which they occur including global climate change, acid deposition reduction, incompatible energy development and infrastructure, invasive species prevention, altered hydrological regimes of streams and rivers, and abandoned coal mining lands. Restoration and stewardship strategies include wetland and stream mitigation, prescribed fire, invasive species control, oyster and eel grass restoration, and rare species recovery efforts. Appendix B describes how TNC develops conservation strategies to abate threats and restore conservation targets in priority places. In general strategies are designed to achieve clearly articulated, measurable conservation objectives.

ELEMENT X. MONITORING AND EVALUATING PROGRESS

The business of TNC is to implement conservation strategies that are intended to maintain or restore biodiversity. To be successful, we need to know whether the trends in the viability and integrity of biodiversity, the status of threats, and the ecological management of conservation lands and waters are heading in a positive direction, holding steady, or declining. Moreover, we need to know whether our strategies are having their intended outcomes and fulfilling measurable conservation objectives. A major component of the Conservation by Design paradigm is measuring results. This is the cornerstone of all good adaptive management. However, it is also the most challenging. We have made progress in the last couple of years, and our organizational commitment to measures is growing, and we are devoting more resources and capacity to this effort now and into the future.

TNC has begun to develop conservation status measures for ecoregions in the northeastern U.S. (including Virginia). In 2006 our Eastern Regional Science team summarized three decades of ecological inventory data, geospatial mapping, advanced predictive modeling techniques, and expert knowledge from the abundant store of academic, state and privately based conservation scientists in the region. The report entitled ―Conservation Status of the Northeastern US and Maritime Canada" (2006) evaluates ecoregional priority conservation areas or portfolios using TNC's recently compiled Secured and Protected Lands data base representing over 150,000 tracts of land in the eastern US and maritime Canada that have conservation value. The report aims to answer the question - *How protected are the places that sustain the biodiversity* *of the region?* To assess the conservation status condition and spatial configuration of three factors were examined: conservation features, existing threats and constraints, and land management status. Some of the sample measures used included:

- Permanently secured lands classified into GAP status 1, 2 and 3
- Ratio of conversion to protection
- Protection of environmental heterogeneity (representativeness)
- Landscape intactness (natural cover)
- Forest protection
- Natural community (non-forest) protection
- Species protection levels (including vertebrate, invertebrate, and plant protection levels)
- Protection of centers of endemism
- Housing density pressure

We intend to conduct this full ecoregional assessment every 5 years.

In addition to these ecoregional measures, several efforts are underway in priority conservation areas throughout Virginia to develop robust conservation status measures. Much of the measures work is being done in partnerships with academic institutions, state and federal agencies. For example, at the Virginia Coast Reserve, our staff biologist works with partners from William and Mary's Center for Conservation Biology (CCB), DGIF, DCR, UVA's Long-Term Ecological Research Station, and US Fish and Wildlife Services to monitor the productivity of American oystercatchers and piping plovers and conduct colonial waterbird and shorebird surveys on barrier islands. In addition, our staff work with the US Forest Service to do fire effects monitoring of oak-pine forests in the George Washington and Jefferson National Forest. In southwestern Virginia, we are working with USFWS, Virginia Tech and DGIF to conduct rare mussel inventories and surveys every summer. Moreover, we work with CCB and USFWS to monitor the annual productivity of red-cockaded woodpeckers at Piney Grove Preserve in Sussex County.

A great deal of monitoring work is already being done by state agencies and academic institutions in priority conservation areas. Examples include DEQ's 303d/305b water quality assessment and biological monitoring work, UVA LTER's extensive water quality data for coastal bays and lagoons of the Eastern Shore, and the EPA's Chesapeake Bay Program annual report card. TNC strategically uses and track data such as this which currently exists to better inform our conservation strategies into the future.

In addition, TNC seeks to measure whether individual strategies and associated actions that we take within a conservation project are having their intended effect and achieved desired conservation outcomes such as abating threats and restoring targets. These measures of strategy effectiveness are used to evaluate progress in achieving desired outcomes and results that stem from implementing our strategies and actions, made explicit by tracking progress toward measurable objectives and the actions associated with them. This is a newer emphasis for the Conservancy, and has stimulated the development of new methods for tracking progress in the implementation of a strategy such as software called Miradi (see below for more information), a user-friendly program that allows nature conservation practitioners to design, manage, monitor, and learn from their projects to more effectively meet their conservation goals. TNC in Virginia has begun to incorporate strategy effectiveness measures into our planning process.

CONCLUSION

The Conservancy will utlize the locations identified on the following pages (Part II) through Conservation by Design as the first priority for siting mitigation projects. As necessary, second priority locations may be identified within Conservancy landscapes or within other conservation partner's area of interest. These second priority sites may be necessary when mitigation needs exist and projects cannot be acquired within the first priority locations.

Above, we have addressed the ways in which TNC's Conservation by Design paradigm including ecoregional assessments and conservation action plans satisfy the elements required by the new EPA compensation planning framework rule required for in-lieu fee mitigation programs. To reiterate, Conservation by Design provides an integrated approach that establishes conservation goals and priorities, guides actions, and directs resources to gain the greatest conservation results. It is an iterative and adaptive approach that operates at multiple scales, from local to global, and has been successfully employed in a diversity of geographic and cultural settings. It is highly effective approach ~~to~~ select, secure, and implement aquatic resource restoration, establishment, enhancement, and/or preservation activities" as required by the new rule.

Many of the concepts and methods of Conservation by Design have been incorporated into the *Open Standards for the Practice of Conservation* Version 2.0 developed by the Conservation Measures Partnership which is a partnership of conservation non governmental organizations, including The Nature Conservancy, African Wildlife Foundation, Wildlife Conservation Society, and World Wide Fund for Nature/ World Wildlife Fund that seek better ways to design, manage, and measure the impacts of their conservation actions. The Open Standards represent the collective experience of its members in conservation project design, management, and monitoring and, as such, provide the steps and general guidance necessary for the successful implementation of conservation projects. The Open Standards can be found at http://www.conservationmeasures.org/CMP/.

In addition, the Conservation Measures Partnership has been key in developing and promoting the use of Miradi software to help practioners implement the Open Standards for the Practice of Conservation by walking them, step by step through designing, managing, monitoring, and learning from their conservation projects. Go to www.miradi.org to lean more. All of these resources are available to the general public.

Moreover, the methods and tools associated with Conservation by Design are available to the public through TNC's Conservation by Design Gateway website: http://conserveonline.org/workspaces/cbdgateway/.

The Conservation by Design Gateway is a ConserveOnline Workspace for the global conservation community to find and share guidance, tools and resources supporting Conservation by Design or the process of setting goals, developing strategies, implementation and measuring results for biodiversity conservation. Industry, state agencies and other non-profit conservation groups can use and adapt this conservation approach to satisfy the new rule, resulting in more strategic mitigation and restoration efforts. The Conservation by Design Gateway provides guidance, tools, resources and case studies that support the approach and methods within Conservation by Design.

PART II. OVERVIEW OF ECOREGIONAL PRIORITY CONSERVATION AREAS BY DEQ/CORPS SERVICE AREAS

SERVICE AREA 1. ATLANTIC OCEAN[1]

A. DESCRIPTION

The Atlantic Ocean service area is found along the ―seaside" of the Eastern Shore of Virginia located on the lower Delmarva Peninsula, and is part of Northampton and Accomack counties. The watershed divide on the Eastern Shore runs roughly along Highway 13 where creeks and streams drain into the coastal bays on the east side of the highway. The seaside of the Eastern Shore is of both ecoregional and global importance for its remarkable estuarine, coastal and marine habitats and spectacular populations of migratory and breeding shorebirds, colonial waterbirds, landbirds and raptors. The coastal lagoons and barrier islands are largely unaltered by human impact and are considered the best remaining Atlantic coast wilderness. The Eastern Shore's enormous ecological value is recognized through its designation as an United Nations International Man and the Biosphere Reserve, an U.S. Department of the Interior National Natural Landmark, a National Science Foundation Long Term Ecological Research Site, and a Western Hemisphere International Shorebird Reserve Network Site.

Protected lands comprise roughly 82,000 acres or 23% of the total area of the Eastern Shore in Virginia. The Commonwealth of Virginia is the largest landowner, owning half of the total protected lands, or roughly 41,700 acres. The Nature Conservancy is the largest private landowner with roughly 19,500 acres in preserves and 5,000 acres in other land holdings, equaling almost 5% of the total Shore area. The U.S. Fish and Wildlife Service (USFWS) owns and manages 4 National Wildlife Refuges that collectively equal 16,500 acres.

The Eastern Shore of Virginia is still considered a largely rural, agrarian refuge on the heavily populated mid-Atlantic seaboard. It historically has been a quiet, sparsely populated land of fishermen and farmers. However, though still a modest 50,000 people in size, the Shore is rapidly changing with the increasing development of second homes and resorts due to the booming population of the Hampton Roads area.

B. PRIORITY CONSERVATION AREAS (SEE MAP 1)

Name	Type	Acres	Stream Miles
Greens Creek	Aquatic Site		9.02
Holt Creek	Aquatic Site		3.62
Lucas Creek	Aquatic Site		7.54
Ross Branch	Aquatic Site		4.95
Lower Eastern Shore	Marine/Estuarine Site	262330	
Assawoman Creek Fen	Terrestrial Non-Matrix Site	80.3	
Assawoman Island	Terrestrial Non-Matrix Site	746.9	
Bell Neck Habitat Zone	Terrestrial Non-Matrix Site	128.7	
Brant Hill Habitat Zone	Terrestrial Non-Matrix Site	10.4	
Cedar Island	Terrestrial Non-Matrix Site	2419.2	
Chancetown Habitat Zone	Terrestrial Non-Matrix Site	134.4	
Chimney Pole Marsh	Terrestrial Non-Matrix Site	270.8	
Cobb Island	Terrestrial Non-Matrix Site	1238.1	
Cunjer Channel Marsh Tumps Habitat Zone	Terrestrial Non-Matrix Site	117.8	

[1] Please note that service area descriptions except for Atlantic Ocean are adapted from Virginia DEQ and DCR's report "Virginia 305(b)/303(d) Water Quality Assessment Integrated Report to Congress and the EPA Administrator for the Period January 1st, 2001 to December 31, 2006"

Name	Type	Acres	Stream Miles
Curlew Bay Marsh Habitat Zone	Terrestrial Non-Matrix Site	441.0	
Elkins Marsh Habitat Zone	Terrestrial Non-Matrix Site	3746.9	
Fishermans Island	Terrestrial Non-Matrix Site	192.3	
Hadlock Roadside Habitat Zone	Terrestrial Non-Matrix Site	3.2	
Hog Island	Terrestrial Non-Matrix Site	3210.2	
Hummock Cove Marsh Habitat Zone	Terrestrial Non-Matrix Site	537.5	
Mappsburg Habitat Zone	Terrestrial Non-Matrix Site	125.5	
Metompkin Island	Terrestrial Non-Matrix Site	1526.0	
Mutton Hunk Fen	Terrestrial Non-Matrix Site	217.9	
Myrtle Island	Terrestrial Non-Matrix Site	253.4	
North Assawoman: South Wallops Island	Terrestrial Non-Matrix Site	86.3	
North Wallops Island	Terrestrial Non-Matrix Site	220.4	
Parramore Island	Terrestrial Non-Matrix Site	6128.2	
Pettit Branch	Terrestrial Non-Matrix Site	339.7	
Ross Branch Habitat Zone	Terrestrial Non-Matrix Site	123.6	
Ship Shoal Island	Terrestrial Non-Matrix Site	538.9	
Smith Island	Terrestrial Non-Matrix Site	2357.6	
Southern Tip Corridor	Terrestrial Non-Matrix Site	18275.5	
Upshur Creek Pinewoods Habitat Zone	Terrestrial Non-Matrix Site	7.8	
Wallops Island Causeway Marshes	Terrestrial Non-Matrix Site	487.2	
Wreck Island	Terrestrial Non-Matrix Site	889.8	
Wye Channel Marshes Habitat Zone	Terrestrial Non-Matrix Site	381.9	

C. CONSERVATION TARGETS

Barrier Island System

The Barrier Island System extends for nearly 60 miles along the seaward margin of the Lower Virginia Eastern Shore and is composed of 18 barrier islands, their associated tidal inlets and sandbars, six back barrier islands, and thousands of acres of fringing salt marshes. With the exception of Wallop's Island, the islands are free to respond naturally to the processes that have shaped and nourished them since the Pleistocene. They have proven to be biologically diverse and resilient even while being subjected to over 400 feet in sea level rise and migrating over 50 miles during the last 12,000 years. Because of the dynamics of the system and its mid-Atlantic location, the natural communities of the islands and their associated plant species are spatially and temporally transitional. The maritime natural communities found on the islands include high-energy upper beaches and overwash flats, peat/sod banks, maritime dune grasslands, maritime scrub, maritime dune woodlands, maritime wet grasslands, interdune ponds, salt flats, maritime lobolly pine forest, maritime mixed forests, salt scrub, tidal mesohaline and polyhaline marsh, and tidal oligohaline marshes.

Barrier Island/Coastal Lagoon Breeding Birds

The Virginia barrier islands provide critical habitat for an extraordinary number and diversity of breeding colonial waterbirds, shorebirds, raptors, passerines and waterfowl including the piping plover (*Charadrius melodus*), Wilson's plover (*C. wilsonia*), American oystercatcher (*Haematopus palliatus*), black skimmer (*Rynchops niger*), least tern (*Sterna antillarum*), gull-billed tern (*S. nilotica*), as well as several species of egrets, herons and ibis. Colonial waterbird and shorebird breeding habitat includes high-energy upper beach and overwash fans, dune grasslands, scrub, and topographical highs (wrack, shell rakes) in the salt marshes. A survey in 2003 found 162 colonies of over 56,600 breeding pairs of waterbirds on the islands, representing over 70% of the breeding waterbirds on the Coastal Plain of Virginia (Watts 2004). Over 200 breeding pairs of piping plovers representing roughly 11% of the Atlantic coast population are currently found on island overwash beaches considered critical habitat for the plovers' recovery (VDGIF, unpubl. data). Over 600 pairs of American oystercatchers, a species of high concern, were found breeding in the barrier island/lagoon system in 2008, 64% of those on the barrier islands (TNC et al., unpubl. data). Long term monitoring between 1976 and 2005 documented a decline in the colonial waterbird breeding population, most especially black skimmers, common terns (*S. hirundo*), gull-billed terns, least terns, and yellow-crowned night herons (*Nyctanassa violacea*) (Williams et al. 2002, unpubl. data). Declines are attributed to poor productivity due to flooding and increased mammalian predation by raccoons and red foxes (Erwin et al. 1998, Erwin et al. 2001, Rounds 2003). Recent increases in the number of piping plover and American oystercatcher pairs on the barrier islands, however, have been attributed in part to efforts to manage mammalian predator populations. The long-term response of colonial waterbird breeding populations is being documented through ongoing population monitoring efforts.

Three species use the marshes for breeding: saltmarsh sharp-tailed sparrow (*Ammodramus caudacutus*), seaside sparrow (*Ammodramus maritimus*), and clapper rails (*Rallus longirostris*). These species to be cryptic and little is known about their productivity on the Eastern Shore. However, we do know that sparrows and rails need large up to 50 ha intact undisturbed marshes for breeding (Watts, unpublished data).

Migratory Shorebirds

High energy beaches and peat banks formed along ocean beaches by island migration over backside marshes host a great density of beach specific migratory shorebirds including red knots (*Calidris canutus*), sanderlings (*Calidris alba*), and semi-palmated plovers (*Charadrius semipalmatus*). In May of 2007, 37% of the hemispheric population of red knots stopped over on the beaches of the Virginia barrier islands, and recent research indicates the abundance of food resources could support even larger population of foraging red knots. Red knots and other shorebirds feed primarily blue mussel spat (*Mytilus edulis*), amphipods (family Gammaridae), and coquina clams (*Donax varabilis*). The hemispheric population of red knots has declined by 90% since 1990 which may be due to the cumulative impacts of global climate change on their Arctic breeding habitat and to declines in the horseshoe crab populations in the Delaware Bay. Abundant intertidal mudflats are exceptionally significant for several migratory shorebirds of conservation concern, including whimbrels (*Numenius phaeopus*), black-bellied plovers (*Pluvialis squatarola*), dowitchers (*Limnodromus* spp.), and dunlins and various sandpipers (*Calidris* spp.). An estimated 80% of the hemisphere's population of whimbrels uses the mudflats as their last coastal stopover before heading inland to the interior Canadian Arctic to nest (Watts and Truitt, unpublished data). They feed on the high densities of fiddler crabs (*Uca pugnax*) which are found in abundance on mudflats in the coastal bays adjacent to the mainland. In addition, migratory oystercatchers also forage on intertidal sand and mudflats on oyster reefs.

Coastal Estuarine System

a. Tidal Saltmarshes

Tidal saltmarshes are intertidal wetlands typically located in relatively protected lagoons behind barrier islands. Numerous critical ecological functions are provided by salt marshes, including shoreline stabilization, fish and wildlife habitat, nutrient and sediment cycling and sequestration, and serving as the basis of primary production with lagoon systems. Salt marshes provide essential breeding, refuge and forage habitats for many fish and invertebrate species. Eastern Shore seaside marine food webs are in large part powered by the continued primary production of over 80,000 acres of tidal salt marsh habitat. From ―The Natural Communities of Virginia Classification of Ecological Community Groups (Version 2.2)" (Fleming et al. 2006):

> Tidal salt marshes are dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), saltgrass (*Distichils spicata*), or some combination thereof. Vegetation composition and stature generally reflect elevation of substrate, which influences salinity and frequency and duration of inundation. Low salt marsh, dominated by the ―short form" of saltmarsh cordgrass, occupies lower surfaces and forms extensive mosaics on the seaside of the Eastern Shore. Saltgrass and saltmeadow cordgrass are the characteristic species of high salt marsh, which typically occurs on slightly elevated surfaces where tides may be less regular and where soils may concentrate salts.

b. Shellfish

Several species of shellfish currently or formerly were integral to the diversity and function of the barrier island lagoon system, most notably the eastern oyster (*Crassostrea virginica*) and hardshell clams (*Mercenaria mercenaria*). Oyster reefs in particular are ―ecosystem engineers" providing several ecological services to the barrier island lagoons. While phytoplankton chiefly control nutrients in the lagoons, healthy oyster beds and reefs play a role in clarifying the water, thereby improving conditions for eelgrass and other species. Moreover, oyster reefs provide habitat for other invertebrates and juvenile fish, and can also help to buffer shorelines from erosion. Migratory oystercatchers also forage on oyster reefs and oyster rakes and rocks. Shellfish reefs also provide hard substrate for several sessile benthic invertebrates such as polychaetes (e.g., sabellids, serpulids), hydroids, bryozoans, and sponges, as well as critical nursery and foraging habitat for juvenile fishes. Due to disease, overharvest and environmental degradation, oysters were termed ―commercially extinct" by the 1990s in the Virginia coastal bays and lagoons. Since then, oysters appear to have developed immunity to the disease dermo, which in combination with restoration efforts has led to healthy recruitment and growth of oyster reefs in the lagoons.

c. Submerged Aquatic Vegetation
Eelgrass (*Zostera marina* L.) is a marine flowering plant that grows in subtidal regions of coastal and is the major seagrass in the Virginia coastal bays. Similar to the shellfish reefs, eelgrass meadows provide numerous ecological services, including food, nursery spawning and refuge locations for blue crab, bay scallops and numerous fish species. In addition, the complex networks of leaves, roots and rhizomes serve to trap and utilize nutrients, and dampen wave action. Eelgrass typically exhibits a seasonal change in abundance, with low biomass in winter months and rapid increases in the spring and early summer. All of the eelgrass on the Eastern Shore was killed by episodes of pandemic wasting disease with a slime mold vector, and auxiliary impact of a 1933 hurricane. Through restoration efforts over the last 5 years, eelgrass meadows are beginning to re-colonize lagoons from Cedar Island south. However, while seagrass rebounded in Chincoteague Bay, peaking 5 years ago, it is now disappearing which may be due to poor water quality and high water temperatures.

c. Tidal Inlets and Channels
Since most of the fish, sharks, mammals and turtles dependent on the coastal bay and lagoon system on the Eastern Shore are migratory (only 15% of the fish fauna are resident), the inlets of the barrier islands are critical migratory pathways or portals between the estuarine system and the Continental Shelf. In addition, the inlets provide important nursery habitat for many species including: juvenile sciaenids such as drum (*Sciaenops ocellatus*), spot (*Leiostomus xanthurus*), croaker (*Micropogonias undulates*), and sea trout (*Cynoscion regalis*), coastal elasmobranches like the sandbar shark (*Carcharhinus plumbeus)*, summer flounder (*Paralichthys dentatus*), blue crabs (*Callinectes sapidus*), loggerhead turtles (*Caretta caretta caretta*) and Kemps-Ridley turtle (*Lepidochelys kempi*). There are two types of channels within the VCR lagoon system: shallow, ephemeral channels and deeper, permanent channels. The species that make use of these channels vary. For example, loggerhead turtles prefer deeper channels, while blue crabs move in and out of shallow channels.

Migratory Waterfowl
The coastal bays of the Eastern Shore have long been noted for their concentrations of migratory and wintering waterfowl, including geese, sea ducks and puddle ducks due to the diversity of habitats and food resources. The interior fresh and brackish marshes and ponds of the barrier islands, along with adjacent salt marshes are prime habitat for puddle ducks such as the black duck (*Anas rubripes*) and the greater snow goose (*Chen caerulescens*). The coastal bays host large concentrations of diving ducks (considered open water bay ducks), including long-tailed ducks (*Clangula hyemalis*), red-breasted mergansers (*Mergus serrator*), buffleheads (*Bucephala albeola*), Atlantic brant (*Branta bernicla*), and scaup (*Aythya marila* and *A. affinis*) that congregate near tidal mudflats and shoals. The coastal bays and islands of the Eastern Shore of Virginia are the major wintering area in the Atlantic flyway for the American black duck and a minor breeding area in the summer months. The interior fresh and brackish marshes and ponds of the barrier islands provide nesting habitat for the breeding black ducks in the summer months, while the open salt marshes of the bays are prime wintering habitat for black ducks which nest in the maritime providences of Canada.

Migratory Landbirds and Raptors
Each fall millions of migratory landbirds and raptors funnel through the lower Delmarva peninsula, making it one of the most important stopover and staging areas along the Atlantic flyway and in the eastern United States (Mabey et al. 1993, Watts and Mabey 1994, Mabey and Watts 2000). It is estimated that 5 to 6 million neotropical (long distance migrant) landbirds and 10 to 12 million temperate (short distance migrant) landbirds pass through the Southern Tip area during their fall migration (Watts and Mabey 1994). Nearly 200 species of neotropical landbirds stop over on the Shore, representing about 70% of all breeding bird species in North America. Long-distance

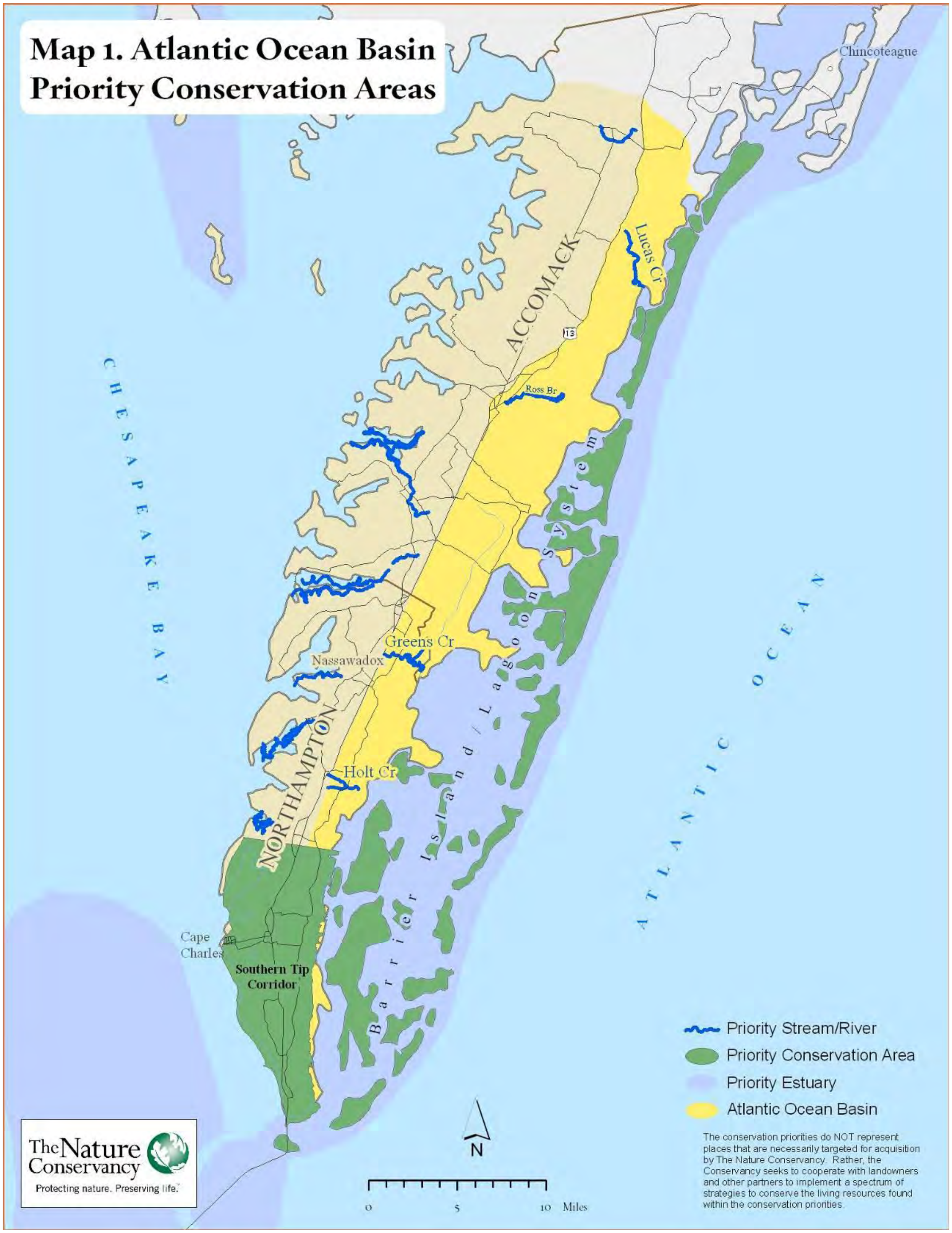
migrants are most abundant during the first half of the migratory period while short-distance migrants are most abundant during the last half of the season, even staying through the winter. Landbirds are generally associated with habitat types on a species-specific basis and within particular strata of forests. The majority of neotropical migrants utilizing the Southern Tip are young of the year, likely funneled to the Shore by cold fronts and prevailing winds (Paxton and Watts 2001). It appears that hardwood dominated forest, with dense understory and high primary energy production (i.e. soft mast and leaf area for insect prey), is superior as stopover habitat to pine dominated forest which is less productive and structurally diverse. Contiguous forest habitat is important because it provides the landbirds with protection from migrating raptors.

While migrants are concentrated in areas close to the Southern Tip coastline (within 0 to 1.5 km), particularly on the lower bayside within the lower 10 km of the peninsula, birds are more abundant on barrier islands than the coastal mainland presumably due to the better foraging resources. Many of the migrant species are experiencing rapid population declines (Mabey et al. 1993, Watts and Mabey 1994). Fully one-half of all migrants flying south for the winter will not return to North America to breed in the spring, particularly those that winter on the Caribbean islands. The Eastern Shore is contributing to the decline in species since many landbirds are not replenishing fat reserves during their stopover on the mainland.

Perennial low gradient sandy bed streams
These streams consist of non-tidal, freshwater reaches of seaside and bayside branches that terminate in tidal creeks and marshes. Streams are low gradient, with stable, perennial groundwater fed flow, and sandy bottoms with heavy accumulation of organic debris, woody debris, and emergent vegetation growth. Water chemistry is acidic to neutral, but has sufficient gradient to prevent heavy accumulation of tannins and formation of blackwater systems. Target supports a naturally depauperate, but distinct Coastal Plain fish community, and some streams may support small runs of hickory and/or American shad. These streams also support a typical Coastal Plain macroinvertebrate community and may contain one or two relict populations of a freshwater mussel, *Elliptio complanata*. While similar streams occur throughout the Coastal Plain province, this target is distinct because of the unique zoogeographic position and young geologic age. The headwaters of these streams may support acidic seepage swamps dominated by mixed hardwoods, pine and shrubby understory. These swamps are characterized by diffuse drainage or braided channels with sphagnum-covered hummock-and-hollow microtopography in an acidic, nutrient-poor, sandy or peaty substrate (Fleming et al. 2006).

D. Threats

- Invasive/ alien mammal species
- Global climate change (sea level rise, water temperature extremes, storm frequency/intensity)
- Overfishing/ dredge fisheries
- Invasive non-native plant species
- Aggressive species
- Incompatible aquaculture practices
- Atmospheric deposition
- Incompatible development
- Incompatible agricultural practices
- Recreational use
- Non-native marine species
- Chesapeake Bay water quality
- Illegal hunting
- Channel dredging
- Wind turbines
- Oil transport/ shipping


Map 1. Atlantic Ocean Basin
Priority Conservation Areas
Chincoteague
ACCOMACK
Lucas Cr
13
Ross Br
CHESAPEAKE BAY
Barrier Island / Lagoon System
ATLANTIC OCEAN
Greens Cr
Nassawadox
NORTHAMPTON
Holt Cr
Cape Charles
Southern Tip Corridor
Priority Stream/River
Priority Conservation Area
Priority Estuary
Atlantic Ocean Basin
The conservation priorities do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation priorities.
N
0
5
10 Miles
The Nature Conservancy
Protecting nature. Preserving life.

SERVICE AREA 2. CHESAPEAKE BAY

A. DESCRIPTION

The Chesapeake Bay/Small Coastal Basin is located in the eastern part of Virginia and covers 1,588 square miles or approximately 4 percent of the Commonwealth's total land area. The basin encompasses the small bays, river inlets, islands and shoreline immediately surrounding the Chesapeake Bay and the southern tip of the Delmarva Peninsula. This basin also includes the Chesapeake Bay itself.

The Chesapeake Bay/Coastal Basin is defined by both hydrologic and political boundaries. The Potomac River Basin, the Rappahannock River Basin, the York River Basin, the James River Basin and the Chowan River-Dismal Swamp Basin border the basin to its west. The Eastern Shore portion is bordered on the west by the Chesapeake Bay, on the north by Maryland, and on the east by the Atlantic Ocean.

The topography of the Chesapeake Bay/Coastal Basin varies little. The entire basin lies within the Coastal Plain Physiographic Province where elevations average no more than a few feet above sea level. More significant elevation occurs along the central spine of the Eastern Shore portion, which forms a plateau about 45 feet above sea level. Much of the Chesapeake Bay/Coastal Basin is marshland. About 30 percent of the Chesapeake Bay/Coastal Basin is forested, while nearly 21.6 percent is in cropland and pasture. Approximately 24 percent is considered urban.

The 2006 population for the Chesapeake Bay/Coastal Basin was approximately 753,634. All or portions of the following jurisdictions lie within the basin: Counties – Accomack, Gloucester, King and Queen, Lancaster, Matthews, Middlesex, Northampton, Northumberland, and York; Cities – Chesapeake, Hampton, Newport News, Norfolk, Poquoson, and Virginia Beach.

Tributaries in the Chesapeake Bay/Coastal Basin drain into the Chesapeake Bay or the Atlantic Ocean. Major tributaries flowing into the Chesapeake Bay from the western shore are the Great Wicomico River, Piankatank River, Fleets Bay, Mobjack Bay including the East, North, Ware, and Severn Rivers, Poquoson River, Back River and Lynnhaven River. Tributaries in the Eastern Shore portion that drain into the Bay are Pocomoke, Onancock, Pungoteague, Occohannock, and Nassawadox Creeks. Machipongo River, Assawoman Creek, Parker Creek, Folly Creek, and Finney Creek drain east directly into the Atlantic Ocean.

B. PRIORITY CONSERVATION AREAS (SEE MAP 2)

Name	Type	Acres	Stream Miles
Dragon Run/Piankatank River	Aquatic Site		225.57
Greens Creek	Aquatic Site		0.04
Holt Creek	Aquatic Site		0.22
Hungars Creek	Aquatic Site		5.90
Occahannock Creek	Aquatic Site		12.26
Rappahannock River	Aquatic Site		4.61
Sandy Bottom Branch	Aquatic Site		5.81
Taylor Creek	Aquatic Site		11.56
The Gulf	Aquatic Site		7.39
Warehouse Creek	Aquatic Site		3.25
York Complex	Marine/Estuarine Site	65261	
Dragon Run	Marine/Estuarine Site	1327	
Dragon Run	Terrestrial Forest Matrix Block	102230.0	
Beach Island	Terrestrial Non-Matrix Site	206.3	
Belle Haven Delmarva Bay Habitat Zone	Terrestrial Non-Matrix Site	291.2	
Butcher Creek/Hacks Neck	Terrestrial Non-Matrix Site	1034.8	
Cape Charles/Picketts Harbor	Terrestrial Non-Matrix Site	97.4	

Name	Type	Acres	Stream Miles
Church Neck	Terrestrial Non-Matrix Site	1233.7	
Clam Marshes	Terrestrial Non-Matrix Site	1369.2	
Coards Branch Pond	Terrestrial Non-Matrix Site	359.2	
Craddock Neck Habitat Zone	Terrestrial Non-Matrix Site	8.7	
Crockett Town Habitat Zone	Terrestrial Non-Matrix Site	129.9	
Eastville Forest	Terrestrial Non-Matrix Site	145.9	
Fishermans Island	Terrestrial Non-Matrix Site	326.1	
Freeschool Marsh	Terrestrial Non-Matrix Site	4886.4	
Hadlock Roadside Habitat Zone	Terrestrial Non-Matrix Site	26.2	
Hyslops Marsh	Terrestrial Non-Matrix Site	953.9	
Long Ridge Habitat Zone	Terrestrial Non-Matrix Site	105.8	
Occohannock Neck	Terrestrial Non-Matrix Site	1334.5	
Old Tree Island Habitat Zone	Terrestrial Non-Matrix Site	42.7	
Parkers Marsh/Island	Terrestrial Non-Matrix Site	2547.7	
Reedtown Stream Bottom Forest	Terrestrial Non-Matrix Site	58.4	
Savage Neck Dunes	Terrestrial Non-Matrix Site	831.4	
Scarborough Neck	Terrestrial Non-Matrix Site	841.5	
Seashore State Park	Terrestrial Non-Matrix Site	4659.1	
Southern Tangier Island	Terrestrial Non-Matrix Site	603.0	
Southern Tip Corridor	Terrestrial Non-Matrix Site	17906.3	
Upper Nassawadox Creek Habitat Zone	Terrestrial Non-Matrix Site	113.3	
Upper Occohannock Creek Habitat Zone	Terrestrial Non-Matrix Site	131.2	

C. Conservation Targets

Tidal Wetlands

Tidal (or estuarine) wetlands, which include saltwater marshes and cedar swamps, experience periodic flooding by ocean-driven tides. Most common are emergent wetlands, dominated by salt-tolerant grasses (e.g. saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), big cordgrass (*Spartina cynosuroides*) saltgrass (*Distichils spicata*)). Though only 4% of the 64,000 square mile watershed qualifies as wetlands, these areas provide a nursery ground that sustains the productivity of the Bay. Tidal wetlands are particularly important habitats for brackish and marine fishes, shellfish, various waterfowl, shorebirds, wading birds and several mammals. Most commercial and game fishes use estuarine marshes and estuaries as nursery and spawning grounds. Menhaden (*Brevoortia tyrannus*), bluefish (*Pomatomus saltatrix*), flounder (*Paralichthys dentatus*), sea trout (*Cynoscion regalis)*, croaker (*Micropogonias undulates*), and striped bass (*Morone saxatilis*) are among the most familiar fishes that depend on estuarine wetlands during their larval stage. In fact, the Chesapeake Bay is the major spawning and nursery ground for striped bass on the East Coast. Blue crabs (*Callinectes sapidus*), the prized shellfish of the Bay, also depend on coastal marshes, as do other shellfish, such as oysters, clams and shrimp. Loss of habitat along waterways poses the biggest threat to most bird species in the Bay watershed. Deforestation, shoreline development and shoreline erosion disrupt nesting activities, and chemical contaminants in the water damage the food source of many Bay birds.

Diadromous Fishes

Diadromous species migrate between freshwater rivers and streams and continental shelf marine waters by way of the Chesapeake Bay and its major tributaries. These species are either anadromous, fishes that live predominantly in saltwater and move to freshwater to reproduce (e.g. blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengu*), hickory shad *Alosa mediocris*), and American shad (*Alosa sapidissima*)) or catadromous, species that spend the majority of life in freshwater and migrate seaward to spawn (e.g. American eel (*Anguilla rostrata*)). Diadromous fish are depend on the estuary for habitat and migration routes, but are sensitive to altered salinity and temperature. Anadromous fish migrate varying distances to spawn in freshwater, some traveling within the Bay to find the appropriate conditions. For example, yellow perch (*Perca flavescens*) and white perch (*Morone Americana*) travel short distances from brackwish water in the middle bay to freshwater areas in the upper Bay or tributaries. Shad and herring must travel from the open ocean to freshwater to spawn and often face terminal migration barriers. Eels, catadromous species, traveling from fresh to salt water to spawn, are subject to overharvest. The stress associated with the physiological changes required to transition between fresh and salt water render these species extremely vulnerable to habitat impacts within freshwater and marine migratory corridors, and a majority of their historic freshwater spawning habitat is no longer accessible due to dams and other barriers.

These species were all formerly abundant within Chesapeake Bay tributaries, and are now either locally extinct, showing declining trends, or at very low levels. From the mid-1800s to the early 1900s, the American shad fishery was the largest in the Bay, but was subjected to a moratorium in 1980 due to the sharp decline of the fishery. The Atlantic States Marine Fisheries Commission adopted a management plan for the species in 1985 that was adopted by PA, MD and VA in 1989 – still, it could take years for the population to rebuild.

Oyster Reef Ecosystem
The eastern oyster (*Crassostrea virginica*) was formally integral to the Chesapeake Bay ecosystem. Oyster reefs are ―ecosystem engineers" providing several ecological services to the Bay: 1) oysters consuming phytoplankton and detrital particles with sequestered nutrients by filtering up to 5 liters of water per hour; 2) oyster reefs provide habitat for communities sessile benthic invertebrates such as polychaetes (e.g., sabellids, serpulids), hydroids, bryozoans, and sponges, as well as critical nursery and foraging habitat for juvenile fishes 3) Oysters supply food for birds, such as the American oystercatcher in intertidal flats. Moreover, oyster reefs can also help to buffer shorelines from erosion. Oyster reefs are typically found in the greatest aggregations at the mouths of rivers and creeks on hard substrate bottom. The historic footprint of oyster reefs in the Chesapeake was likely between 200,000 and 400,000 acres; today fewer than 20,000 acres are likely functional. As recently as 100 years ago, they were so massive that they posed a navigational hazard to ships. However, populations are suffering as a result of disease, habitat destruction and over-harvesting and are estimated to exist at only 1% of historic levels.

Underwater Grass Ecosystem
This target includes a diverse assemblage of rooted macrophytes found in shoal areas and from the mouth of headwaters throughout tributaries. This system provides food and habitat for waterfowl, fish, shellfish and invertebrates while also protecting shorelines from erosion, by stabilizing the bottom and absorbing some wave energy. Often referred to as submerged aquatic vegetation (SAV), these plants allow for an exchange of gas and nutrients that helps filter the Bay of excess nutrients while producing oxygen, a vital and sometimes lacking commodity in the Bay. Starting in the late 1960s the Bay suffered a bay-wide decline in all SAV species, attributed to increased nutrient and sediment loading resulting from development in the watershed.

Sea turtles/Marine Mammals
Marine mammals are highly migratory and seasonal throughout the mid-Atlantic and Chesapeake Bay. The Bay provides critical juvenile and foraging habitat between April and November for the northern migratory stock of the bottlenose dolphin (*Tursiops truncates*). Humpback whales (*Megaptera novaeangliae*) utilize the lower Bay and bay mouth as winter foraging habitat (Swingle et al. 1993). In the Bay the bottlenose may venture as far north as the Miles or Potomac River and feeds on catfish, eels, menhaden, mullet, shrimp, crabs and squid. Manatees have been sighted in coastal waters and estuaries.

Omnivorous loggerhead turtles (*Caretta caretta caretta*) also visit the lower Bay during summer months to feed and travel the deep channels. The Chesapeake Bay is critical juvenile nursery habitat for the loggerhead between May and October, with as many as 10,000 juveniles entering the Chesapeake Bay during this time. Loggerheads have shown a 60% decline in summer populations in the Bay in recent years (Musick, unpublished data). The mid-Atlantic also provides critical juvenile nursery habitat for the Kemp's Ridley turtle (*Lepidochelys kempi*), the second most abundant sea turtle in the mid-Atlantic and the world's most endangered sea turtle. The species feeds on estuarine flats and during the summer and then congregates in the near-shore environment during the fall before it makes its winter migration south of Cape Hatteras. Between 300-1200 individuals are estimated to migrate to the Chesapeake Bay each summer (J. Musick, personal communication, 2006).

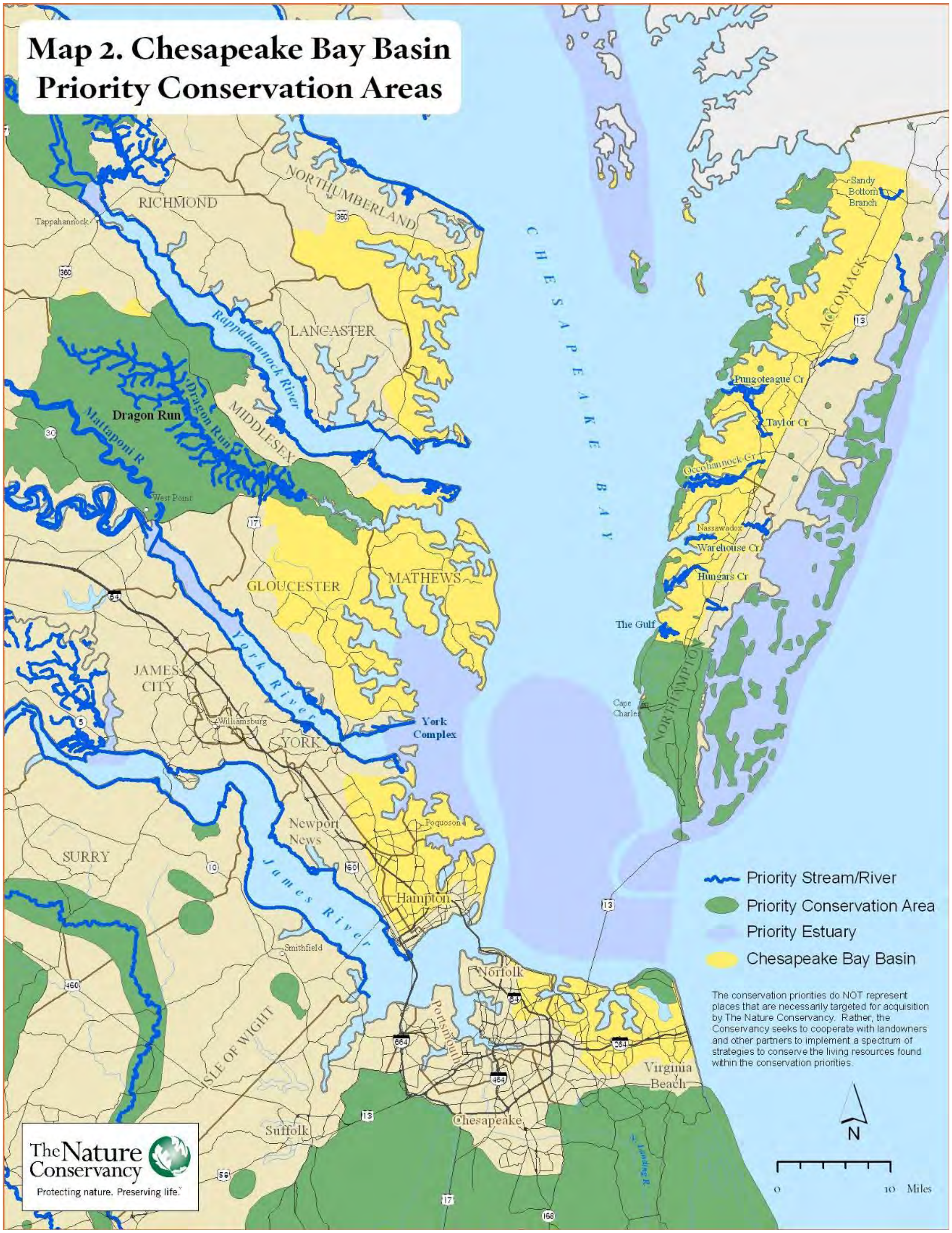
Beaches and Mudflats
The shoreline of the Chesapeake Bay and its tidal tributaries, including all tidal wetlands and islands, is over 11,600 miles - more shoreline than the entire west coast of the United States (CBP, 2003). These inter-tidal habitats support a number of species, including waterfowl, shorebirds, clams, tiger beetles and Diamondback terrapins (*Malaclemys terrapin*) (under regulated harvest in MD since 1929 due to threats of overharvest). Chesapeake Bay beaches provide habitat for two of Maryland's endangered species: the puritan tiger beetle (*Cicindela puritana*) which has been found in only about 10 sites in Calvert County and one other site along the Connecticut River and the Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*). Hard clams (*Mercenaria mercenaria*) are found primarily in the higher salinity waters of the Bay, starting as pelagic larvae that settle into mudflats to reach maturity. Their spawning cycles are greatly affected by water temperatures and the availability of food. Though birds are able to roam, they do require nesting and nursery grounds. Shoreline development, toxic and nutrient pollution and natural stressors such as drought or saturating storms can damage these habitats and increasingly influence the life cycles of all Bay birds.

Mud/Sand Benthic Communities
The dominant benthic habitat throughout Bay is made up of sand and mud, home to bacteria, clams, worms and other creatures that serve as key food source for higher levels of aquatic life. This community is an indicator of the overall health of the Bay since it was historically the foundation of the entire food web; today it is vulnerable to stresses associated with pollution, excess nutrients, oxygen content and sediment concentrations. Deeper portions of this habitat are subjected to anoxia and hypoxia (exacerbated by excess nutrient loading), which limit the biological diversity of the system through changed food web dynamics.

Piscivorous Fish and Sharks
The target includes the Bay's predatory (or fish-eating) species: striped bass, cobia, weakfish, bluefish and sandbar sharks (*Carcharhinus plumbeus)*. The Bay serves as the key Atlantic coast nursery for striped bass, sandbar sharks and weakfish. Many species are subjected to over-harvest as a result of industrialized commercial fishing practices. As a result of toxic bioaccumulation in some Bay species, the Maryland Department of the Environment publishes consumption advisories to inform the public of health risks of consuming tainted fish.

D. THREATS

- Global climate change (Sea level rise and increased climatic variability)
- Upland development - stormwater and sediment alterations
- Agricultural sources of nutrients and sediment
- Atmospheric sources of nutrients
- Shoreline hardening/modification
- Altered freshwater flows and lost connectivity
- Overfishing
- Aquatic invasive species
- Wastewater treatment plants
- By-catch (pound nets)
- Power boating
- Ship strikes
- Terrestrial invasive species
- Dredging
- Wetland ditching
- Directed eel fishery


Map 2. Chesapeake Bay Basin Priority Conservation Areas
RICHMOND
NORTHUMBERLAND
LANCASTER
MIDDLESEX
Rappahannock River
Dragon Run
Dragon Run
Mattaponi R
GLOUCESTER
MATHEWS
JAMES CITY
York River
York Complex
YORK
Newport News
Poquoson
Hampton
SURRY
James River
Smithfield
Norfolk
Portsmouth
ISLE OF WIGHT
Suffolk
Chesapeake
Virginia Beach
CHESAPEAKE BAY
ACCOMACK
NORTHAMPTON
Sandy Bottom Branch
Pungoteague Cr
Taylor Cr
Occohannock Cr
Nassawadox
Warehouse Cr
Hungars Cr
The Gulf
Cape Charles
Priority Stream/River
Priority Conservation Area
Priority Estuary
Chesapeake Bay Basin
The conservation priorities do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation priorities.
N
0 10 Miles
The Nature Conservancy
Protecting nature. Preserving life.

SERVICE AREA 3. CHOWAN RIVER

A. DESCRIPTION

The Chowan River and Dismal Swamp Basin are located in the southeastern portion of Virginia and cover 4,061 square miles or approximately 10 percent of the Commonwealth's total area.

The Basin extends eastward from Charlotte County to the Chesapeake Bay. The Chowan River-Dismal Swamp Basin in Virginia is defined by both hydrologic and political boundaries - the James River Basin to the north, the Small Coastal River Basins to the east, the Roanoke River Basin to the west and the Virginia/North Carolina State line to the south border the basin. The basin is approximately 145 miles in length and varies from 10 to 50 miles in width. The Chowan River-Dismal Swamp Basin flows through the Piedmont and Coastal Plain Physiological Provinces. The Chowan portion flows 130 miles from east to west, crossing both the Piedmont and Coastal Plain, while the Dismal Swamp lies entirely within the Coastal Plain. The Piedmont portion is characterized by rolling hills, steeper slopes and somewhat more pronounced stream valleys. The Coastal Plain, in contrast, is nearly flat with a descending series of terraces.

The Chowan River-Dismal Swamp Basin is mostly rural with approximately 64 percent of its land covered by forest. Cropland and pasture make up another 28 percent, while only about 6 percent is classified as urban.

The 2006 population for the Chowan River-Dismal Swamp Basin was approximately 397,003. All or portions of the following 13 counties and five cities lie within the basin: counties – Brunswick, Charlotte, Dinwiddie, Greensville, Isle of Wight, Lunenburg, Mecklenburg, Nottoway, Prince Edward, Prince George, Southampton, Surry, and Sussex; Cities – Chesapeake, Emporia, Franklin, Petersburg, Suffolk, and Virginia Beach.

Major tributaries of the Chowan River are the Meherrin, the Nottoway and the Blackwater. The Nottoway and the Blackwater join at the Virginia/North Carolina state line to form the Chowan River. The Dismal Swamp portion is mostly flat with many swamp and marshland areas.

B. PRIORITY CONSERVATION AREAS (SEE MAP 3)

Name	Type	Acres	Stream Miles
Assamoosick Swamp	Aquatic Site		27.75
Bears Element Creek	Aquatic Site		6.52
Big Juniper Creek	Aquatic Site		9.89
Blackwater River	Aquatic Site		104.41
Butterwood Creek	Aquatic Site		18.04
Chowan River	Aquatic Site		37.48
Couches Creek	Aquatic Site		5.10
Ledbetter Creek	Aquatic Site		3.67
Mason Creek	Aquatic Site		2.76
Meherrin River	Aquatic Site		68.81
Middle Meherrin River	Aquatic Site		14.42
North Meherrin River	Aquatic Site		31.54
Nottoway River	Aquatic Site		121.62
Reedy Creek	Aquatic Site		5.50
Sewish Creek	Aquatic Site		1.88
South Meherrin River	Aquatic Site		18.49
Stony Creek	Aquatic Site		29.31
Unnamed tributary	Aquatic Site		2.80
Waqua Creek	Aquatic Site		20.35
White Oak Creek	Aquatic Site		15.28

Name	Type	Acres	Stream Miles
Big Woods/Piney Grove	Terrestrial Forest Matrix Block	54387.9	
Forks Of The Meherrin	Terrestrial Forest Matrix Block	40578.1	
Ft Pickett	Terrestrial Forest Matrix Block	32638.3	
Headwaters Of The Nottoway/Falls Of The Nottoway	Terrestrial Forest Matrix Block	38121.0	
Racoon Creek	Terrestrial Forest Matrix Block	13902.0	
Sweathouse Creek	Terrestrial Forest Matrix Block	0.0	
Back Bay And False Cape	Terrestrial Non-Matrix Site	40170.3	
Big Hounds Creek Granite Flatrock	Terrestrial Non-Matrix Site	34.7	
Chowan Sand Ridge/Blackwater River	Terrestrial Non-Matrix Site	84967.3	
Dundas Granite Flatrock	Terrestrial Non-Matrix Site	51.0	
Flatrock Branch	Terrestrial Non-Matrix Site	60.1	
Fort Pickett Dove Field #6	Terrestrial Non-Matrix Site	35.2	
Fort Pickett Firing Point B-54	Terrestrial Non-Matrix Site	1.7	
Fort Pickett Impact Area Macrosite	Terrestrial Non-Matrix Site	311.0	
Great Creek Forest	Terrestrial Non-Matrix Site	198.2	
Green Sea	Terrestrial Non-Matrix Site	266964.0	
Hobbs Chapel	Terrestrial Non-Matrix Site	7.7	
Long Branch Granite Flatrock	Terrestrial Non-Matrix Site	28.6	
Lummis Flatwoods	Terrestrial Non-Matrix Site	1378.9	
Meherrin River	Terrestrial Non-Matrix Site	29734.0	
Nottaway Bluff	Terrestrial Non-Matrix Site	25761.0	
Nottoway Basin Macrosite	Terrestrial Non-Matrix Site	588.4	
Nottoway Basin Sw	Terrestrial Non-Matrix Site	4.6	
Nottoway River	Terrestrial Non-Matrix Site	2949.6	
Nottoway River - Fort Pickett Scu	Terrestrial Non-Matrix Site	65.6	
Nottoway-Tommeheton Divide	Terrestrial Non-Matrix Site	50.1	
Rocky Mill Powerline	Terrestrial Non-Matrix Site	77.0	
Rt. 610 Roadside	Terrestrial Non-Matrix Site	7.7	
Va Powerline Bogs	Terrestrial Non-Matrix Site	37399.6	
Va Site #9	Terrestrial Non-Matrix Site	4703.5	

C. CONSERVATION TARGETS

Roanoke Logperch and associated Fall Zone Fishes
A distinct community of warmwater fish reside occupy the habitat of the Fall Zone in the Nottoway and Meherrin watersheds. The Fall Zone as defined by Jenkins and Burkhead (1994) ~~is~~ fairly gentle; typically, long pools are interspersed with short riffles and , rarely, low cascades. Its ecological boundaries are indistinct; in some streams, habitats typical of the upper Coastal Plain occur in distinctly above the Fall Zone and the converse ensues below the zone." This Fall Zone fish assemblage, of which the federally endangered, globally rare Roanoke logperch (*Percina rex*) is part, is significant due to the presence of species that are disjunct from mountain streams and rivers and/or extremely rare in the Piedmont at large. This assemblage includes the following species: bull chub (*Nocomis raneyi*), bridle shiner (*Notropis bifrenatus*), black jumprock (*Scartomyzon cervinus*), and Roanoke bass (*Ambloplites, cavifrons*). The Roanoke logperch is the rarest of these fish and occurs only in Roanoke and Chowan drainages, but is most plentiful in the Nottoway drainage along the Fall Zone.

Atlantic Pigtoe and Associated Rare Mussel Assemblage

Nine species of mussels considered rare, declining or disjunct occur in the Nottoway and Meherrin watersheds. The rarest and most significant of these species in the Chowan is the Atlantic pigtoe (*Fusconaia masoni*), a species that is extirpated or imperiled throughout its distribution but has healthy populations in the Nottoway and Meherrin. Other target species include the dwarf wedgemussel (*Alasmidonta heterodon*), alewife floater (*Anadonta implicata*), yellow lance (*Elliptio lanceolata*), Roanoke slabshell (*Elliptio roanokensis*), yellow lampmussel (*Lampsilis cariosa*), green floater (*Lasmigona subviridis*), tidewater mucket (*Leptodea ochracea*), and the eastern pond mussel (*Ligumia nasuta*). These mussels require clean, slow to swift flowing waters with silt-free, stable substrates consisting of variable mixtures of sand, gravel and cobble. Important host fish species that have been identified in the Chowan basin are the bluegill sunfish and shield darter for the Atlantic pigtoe, the alewife for the alewife floater and potentially the yellow lampmussel and the tidewater mucket, the tessellated darter (*Etheostoma olmstedia*), johnny darter (*E. nigrum*) and the mottled sculpin (*Cottus bairdi*) for the dwarf wedgemussel.

Blackwater Swamp Aquatic Systems

These are slow-moving, Coastal Plain headwater streams that have their origin in the Coastal Plain and flow over sands, gravels and acidic clays. They are characterized by a high dissolved organic carbon concentration, high acidity, low buffering capacity and nutrient concentrations, carrying low suspended solid loads due to their very low slope gradient (usually less than 0.1%) (Smock and Gilinsky 1992). Floodplain forests are an integral part of the functioning and ecology of blackwater systems. These aquatic systems are important hotspots for biological diversity on the Coastal Plain, teaming with benthic macroinvertebrates, mollusks, salamanders, reptiles, and fish communities. In particular, blackwater swamps are high quality spawning, nursery and foraging habitat for anadromous clupeids. Moreover, because of the high arthropod populations and mast producing trees, these are important stop-over areas for neotropical migratory songbirds. The high productivity of the systems and their complex habitat structure (downed woody debris and snags) support intricate aquatic food webs. Primary threats are degradation and altered hydrology due to habitat conversion or logging.

Atlantic White Cedar (AWC) Swamp Forest.

These palustrine saturated forests found on organic soil deposits (peatlands) consist of a canopy dominated by even aged stands of AWC (*Chamaecyparis thyoides*) intermingled with water tupelo *(Nyssa biflora*) and red maple (*Acer rubrum*) and a shrubby understory of pocosin shrubs. AWC swamp forests are part of a mosaic of other peatland vegetation, including pond-pine woodlands, non-riverine swamp forests and pocosins; however, they are distinct compositionally and structurally from other peatland associations due to a particular fire regime characterized by infrequent (>100 years) and catastrophic fires (Weakley and Schafale 1990). AWC is globally rare, occurring in small patches of the mid-Atlantic coastal plain of southeastern Virginia, North Carolina and South Carolina. Remnant patches found in central and southern portions of the Great Dismal Swamp are considered some of the highest quality remaining stands in the Green Sea (Fleming and Moorhead 1998). Only small remnants can be found in the project area due to a long history of logging coupled with frequent fires (a slash and burn scenario) and a lower water table—a combination that decimated both mature trees and seedlings.

Freshwater Wind-Tide Marshes.

These estuarine marshes are a patch mosaic of spikerush-Olney three square marshes (*Eleocharis fallax and E. rostellata* and *Scirpus americanus*), sawgrass (*Cladium mariscoides*), big cordgrasss (*Spartina cynosuroides*) marshes and black needle rush (*Juncus roemerianus*) marshes. They are found far inland—the closest inlet is over 100 km away—and are therefore maintained by wind tides rather than lunar tides. These marshes are akin to oligohaline marshes characteristic of the estuarine embayments of the mid-Altlantic coastal plain, yet are distinctive in that they are found in a predominately freshwater regime. Likewise, they are atypical of freshwater tidal marshes in their close association with estuarine oligohaline vegetation. Freshwater wind-tide marshes are considered to be globally rare. In Virginia, these marshes are distributed along the North Landing and Northwest Rivers representing the most extensive and exemplary occurrences in the world (Fleming and Moorhead 1998). The marshes support numerous state and globally rare species and provide habitat for waterfowl, amphibians and mammals.

Canebrake

Historically, the wet terraces of shallow peat over mineral soils supported a vast, open savanna-like ―green sea" of giant cane (*Arundinaria gigantea spp. Tecta.)* with a scattered pond pine *(Pinus serotina)* overstory that was maintained by frequent fire (Frost 1995). However, much of the habitat supporting the canebrake communities has been ditched, drained and cleared for agricultural purposes. The current condition of extant canebrake communities is severely degraded due to fire suppression, having succeeded to wet mixed pine-hardwood, pocosin/pond pine woodlands and in some cases, wet non-riverine hardwood forests. However, dense understories of cane persist throughout these forests. The relictual occurrences represent robust –biological stock" and can be restored through proper fire management (Fleming and Moorhead 1998).

Seepage Wetlands *(adapted from Fleming et al 2009)*
Primarily refers to acidic seepage bogs fed by groundwater that occur throughout powerline right-of-ways in the Chowan Basin. These bogs are relegated to powerlines due to fire suppression, hydrological alteration and destruction of surrounding pine-hardwood matrix habitat, and are now maintained by mowing. They serve as refugia for many globally rare plant species that have no naturally occurring habitat left in the northern portion of the mid-Atlantic Coastal Plain ecoregion. Vegetation is a mosaic of scattered trees, shrubs and herbaceous patches dominated by graminoids. Acidic seepage swamps differ in that they are characterized by closed canopy hardwood forests. Seepage wetlands are important habitat for breeding odonates. Rare species associated with seepage wetlands include pine-barren reed-grass (*Calamovilfa brevipilis*), Barratt's sedge (*Carex barrattii*), a sedge (*Carex* sp. 4), Cuthbert turtlehead (*Chelone cuthbertii*), shortleaf sneezeweed (*Helenium brevifolium*), creeping St. John's-wort (*Hypericum adpressum*), New Jersey rush (*Juncus caesariensis*), small capitate beakrush (*Rhynchospora cephalantha* var. *attenuata*), Carolina peatmoss (*Sphagnum carolinianum*), inundated peatmoss (*Sphagnum inundatu*), Virginia least trillium (*Trillium pusillum* var. *virginianum*), Piedmont meadow-rue (*Thalictrum macrostylum*).

Bottomland Hardwood Forests
Bottomland hardwood forests are defined as alluvial floodplain communities that vary from mixed hardwoods in temporarily flooded, well-drained terraces (floodplain forests) to seasonally to mixed hardwoods or cypress-gum in semi-permanently flooded swamps (swamp forests). Floodplain and swamp forests serve as critical habitat for a diversity of birds, amphibians, reptiles, aquatic organisms during early stages of their life history, and small mammals including two rare bat species (see below). Moreover, bottomland hardwood forests provide critical ecological services to aquatic systems by controlling floods, filtering excessive nutrients and sediment from the uplands, providing detritus and food sources for an array of biota from birds to mussels, controlling water temperature, and providing complex channel morphology that regulates flow regimes and provides healthy habitat structure. Associated rare species include *Scirpus flaccifolius*, eastern big-eared bat (*Corynorhinus rafinesquii macrotis*), and southeastern myotis (*Myotis austroriparius*). While substantial logging of mature stands has occurred over the last decade, extensive areas of good examples of bottomland forests remain along the mainstem rivers of the Chowan and Pamlico drainages.

Red-Cockaded Woodpecker and Pine Savanna Habitat
Red-cockaded woodpeckers (*Picoides borealis*), endemic to the southeastern United States, were listed as endangered in 1970 and received federal protection with the passage of the Endangered Species Act in 1973. By the time it was listed, this once-common bird had declined to fewer than 10,000 individuals in widely scattered and isolated populations. This precipitous decline was caused by an almost complete loss of habitat, particularly fire-maintained old-growth pine savannas and woodlands, which no longer exist except in small patches. Longleaf pine (*Pinus palustris*) ecosystems, of primary importance to RCWs, are now among the most endangered ecosystems on Earth. Late- successional shortleaf (*P. echinata*), loblolly (*P. taeda*), and slash pine (*P. elliottii*) ecosystems, important to RCWs outside the range of longleaf, also have suffered severe declines. Decline in Virginia's RCW population has been documented since the early 1950s. By the 1980s, severe habitat loss and degradation threatened the species with extinction. Between 1977 and 1980, over 50% of the known state population disappeared. In 2002, the population plummeted to its lowest point: two breeding pairs at Piney Grove in Sussex County, the last remaining site for the species in Virginia. Piney Grove Preserve owned and managed by The Nature Conservancy represents the northernmost population of RCWs across their range. Since the Conservancy's acquisition of Piney Grove Preserve in 1998, intensive habitat restoration and population management have resulted in the recovery of the population to six breeding pairs. The minimum population goal for the bird at Piney Grove Preserve is

13 breeding groups. If properly managed, the 2,700-acre preserve (plus an additional 500 acres located to the immediate south) is expected to support 13-22 breeding groups.

Southern Pine Savannas
Southern pine savannas and open woodlands once dominated the southeastern Coastal Plain of the United States. These communities are comprised of relatively sparse pine canopies, open understories and a ground cover consisting of grasses, forbs, shrubs and small trees. Longleaf pine is thought to have been the dominant canopy pine across much of the Coastal lain at the time of European settlement. Other pines include loblolly, pond*,* shortleaf and slash. Prior to European settlement, the old-growth pine forests of the southeastern U.S. covered more than 24 million hectares. The biological diversity of this forest region, considered the largest conifer forest area east of the Mississippi, is among the highest in North America. It is recognized as having been a refugium during the Pleistocene and is considered a major area of species richness for amphibians, reptiles, and vascular plants. The understory vegetation of certain longleaf forest types has some of the highest observed levels of plant species richness in the world, with over 140 species documented in a 1/10 ha plot. The relatively sparse tree density of pine savannas maintained by regular fire allows high levels of sunlight to penetrate the canopy and reach the forest floor, encouraging the species-rich understory. Nearly 70% of mammal and over 30% of bird species associated with the longleaf ecosystem forage primarily on or near the ground, indicating the critical role played by fire in maintaining ground cover for wildlife diversity.

This ecosystem was maintained by low-intensity ground fires caused by lightning strikes and indigenous people. Fires occurred over vast areas on approximately three to five year intervals and maintained forest with an open mid-story and dense cover of forbs and grasses. However, the last three centuries have seen extensive land clearing for agriculture, exploitation of mature pines for the naval stores industry, and the suppression of wildfire. Severe declines in the abundance and distribution of pine savannas occurred by the early 1800's in Virginia. Today, dense hardwood mid-stories and closed-canopy pine and pine hardwood forest have replaced the open pine savannas. Currently, pine savannas only occur on less than 3% of their former range. This loss of habitat has led to the drastic decline of many species, and currently over 30 plant and animal species associated with longleaf pine ecosystems are threatened or endangered, including RCW.

Piedmont Mixed Hardwood Forest Matrix Block *(adapted from Fleming et al. 2006)*
Characteristic matrix of xeric to mesic upland mixed hardwood forests typical of the Piedmont transitioning to the inner Coastal Plain. Dominant matrix forming forest types run the gamut from rich, mesic and fertile to xeric, acidic and depauperate depending on soils, moisture and landform. Mesic mixed hardwoods, acidic oak-hickory and oak-heath forests are the dominant forest types. Mesic mixed hardwoods are found on slopes, ravines and in well-drained uplands that are mesic and have infertile soils, composed of beech (*Fagus grandifolia*), oaks (*Quercus spp.*), tulip poplar (*Liriodendron tulipifera*)and hickories (*Carya spp.*). In contrast to mesic mixed hardwoods, basic and acidic oak-hickory forests occur on drier upland sites of subacidic to basic bedrock and are characterized by several oak species, deciduous ericads and a somewhat diverse understory (basic forests have higher herbaceous diversity than acidic forests). Oak-heath forests occur on the driest, most infertile and acidic sites as large patches of ―flatwoods", consisting of several oak and pine species, dense colonies of mountain-laurel (*Kalmia latifolia*) and dangleberry (*Gaylussacia frondosa*) in the understory, and very few to no herbaceous species. Rare species found in Piedmont mixed hardwood froest matrix blocks include blue-hearts (*Buchnera americana*), basil mountain-mint (*Pycnanthemum clinopodioides*), Torrey's moutain-mint (*P. torrei*), and Michaux's sumac (*Rhus michauxii*). Large, contiguous areas of Piedmont forest communities both natural and managed are uncommon, especially in the Piedmont due to centuries of land clearing and increasing urbanization of the landscape.

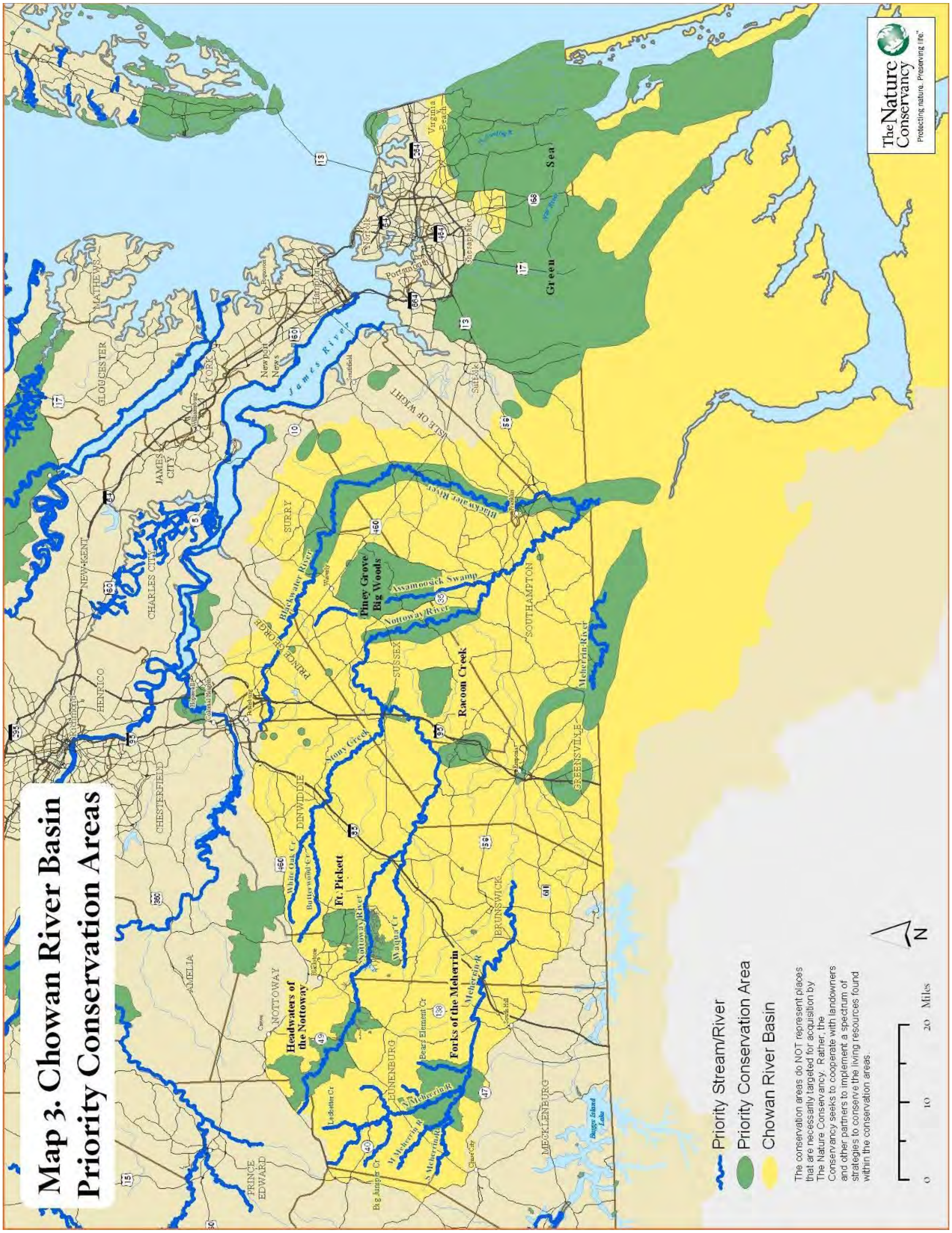
Granite Flatrock Community *(adapted from Fleming et al 2009)*
Exposed, gently sloping, granitic outcrops of the Piedmont ecoregion that support distinctive communities characterized by lichens and sparse vascular plants. Granitic Flatrocks in Virginia range in elevation from about 70 to 100 m (230 to 320 ft) and occur on true granites and a range of related rocks such as granitic gneisses and granodiorites. Most examples are located on gentle slopes along streams, where the erosive power of water over time has worn rock surfaces smooth and created small, gravel-filled depressions. The dominant biota on granitic flatrocks are lichens (*e.g.*, *Xanthoparmelia conspersa*, *Cladonia caroliniana*, and other *Cladonia* ssp.) and the bryophyte *Grimmia laevigata*, which cover much of the exposed bedrock. However, vascular plants dominate

locally in crevices, flats, and depressions where moisture and thin layers of detritus accumulate. Among the vascular plants, Small's stonecrop (*Diamorpha smallii*), Small's purslane (*Portulaca smallii*), and granite loving flat sedge (*Cyperus granitophilus*) are globally rare and endemic to these habitats.

Pyrophytic Low Pocosin/Pond Pine Woodland Complex.
This peatland target encompasses a successional continuum of pyrophytic low pocosin, high pocosin and pond pine woodland. Successional stage is a function of fire frequency, peat depth, and to a lesser extent, nutrient availability. Pyrophytic low pocosins (distinct from the trophic low pocosins of North Carolina), the most frequently burned seral stage (fire return interval of 2-5 years) are open, low stature shrublands consisting of fetterbush (*Lyonia lucida*) and sheeplaurel (*Kalmia carolina*) with a sparse pond pine (*Pinus serotina*) canopy and a relative abundance rare orchids, sedges and forbs (Clampitt et al. 1993). High pocosin is similar but less frequently burned (every 5-15 years) with higher density, taller shrub layer, the herbaceous layer consisting primarily of the Virginia chain fern (*Woodwardia virginica*) (Frost 1995 and Fleming and Moorhead 1998). Pond pine woodlands are infrequently burned (every 15-50 years) with a more closed canopy of pond pine and a lower shrub density (Frost 1995 and Fleming and Moorhead 1998). This peatland matrix is found in patches throughout the Great Dismal Swamp in localized areas on peat flats along the Northwest and North Landing Rivers. Pocosins are globally rare community types and are endemic to the outer coastal plain of the mid-Atlantic embayed region. Because of fire suppression, pyrophytic low pocosin is virtually extirpated from the project area and only scant examples of high pocosin remain, both having been replaced by mature stands of pond pine woodland and forest.

D. THREATS

- Global climate change (sea level rise)
- Incompatible development
- Hazardous/ toxic spills
- Water withdrawals and impoundments
- Ditching, diking, draining of wetlands
- Non-native, invasive species
- Incompatible road building/ improvements
- Incompatible silviculture practices
- Fire suppression
- Incompatible agricultural practices
- Mining (gravel, sand, titanium)
- Point Sources (industrial discharges, SWTP)
- Land conversion/ development
- Deer overbrowse
- Aging septic systems
- Incompatible CAFOs


Map 3. Chowan River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Chowan River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
0 10 20 Miles
N
Headwaters of the Nottoway
Ft. Pickett
Forks of the Meherrin
Racoon Creek
Piney Grove Big Woods
Green Sea
James River
Blackwater River
Nottoway River
Meherrin River
Assamoosick Swamp
Stony Creek
The Nature Conservancy
Protecting nature. Preserving life.

SERVICE AREA 4. LOWER JAMES RIVER

A. DESCRIPTION

The Lower James River Basin occupies the central portion of Virginia and covers 1,678 square miles or approximately X percent of the Commonwealth's total land area. It is bounded by the York River basin to the north and the Chowan basin to the south. The lower James flows from the Fall Line in Richmond for 111 miles before entering the Chesapeake Bay. The Fall Zone is a three-mile stretch of river running through Richmond where the river descends 84 feet as it flows from the resistant rocks of the Piedmont to the softer sediments of the Coastal Plain.

Over 50 percent of the James River Basin is forested, with 22 percent in cropland and pasture. Almost 5% percent is considered urban. The lower James basin is home to Hampton Roads one of the biggest population centers in Virginia with over one million people to the eastern side of Richmond, including Petersburg. All or portions of the following counties and cities lie within the basin: Charles City, Chesterfield, Chesapeake, Hampton City, Hanover, Henrico, Hopewell City, Isle of Wight, James City, New Kent, Newport News city, Norfolk city, Portsmouth, Prince George, Richmond city, Suffolk city, Surry, Virginia Beach, Williamsburg and York.

B. PRIORITY CONSERVATION AREAS (SEE MAP 4)

Name	Type	Acres	Stream Miles
James River	Aquatic Site		28.63
Lower Chickahominy River tributaries	Aquatic Site		158.41
Mainstem James River (tidal freshwater zone)	Aquatic Site		116.90
Chickahominy	Marine/Estuarine Site	11249	
College Run	Terrestrial Non-Matrix Site	1795.4	
Fort Lee	Terrestrial Non-Matrix Site	607.9	
Green Sea	Terrestrial Non-Matrix Site	38182.3	
Lummis Flatwoods	Terrestrial Non-Matrix Site	1540.7	
Muddy Cross Ponds	Terrestrial Non-Matrix Site	4196.6	
Powell Creek Marsh	Terrestrial Non-Matrix Site	7322.8	
Va Powerline Bogs	Terrestrial Non-Matrix Site	629.5	

C. CONSERVATION TARGETS

Tidal Freshwater Marshes *(adapted from Fleming et al. 2006)*
This is a diverse group of herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of inner Coastal Plain rivers and tributaries. In Virginia, tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. Strictly speaking, freshwater conditions have salt concentrations < 0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (*Peltandra virginica*) dotted smartweed (*Polygonum punctatum* var. *punctatum*), wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), rice cutgrass (*Leersia oryzoides*), tearthumbs (*Polygonum arifolium* and *Polygonum sagittatum*), and beggar-ticks (especially *Bidens laevis* and *Bidens coronata*). Locally, sweetflag (*Acorus calamus*), waterhemp pigweed (*Amaranthus cannabinus*), marsh senna (*Chamaecrista fasciculata* var. *macrosperma*), and southern wild rice (*Zizaniopsis miliacea*) may form dominance patches. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (*Nuphar advena*), although cryptic submerged aquatic species may also be present. Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes.

Coastal Plain Mixed Hardwood Forests

Well-drained upland forests consisting of beech, oaks, hickories, pines and other common hardwood species; drier, acidic variants consist of strong ericad shrub component, little herbaceous cover and overall low species diversity; richer, mesic variants have higher (almost double) species diversity with paw-paw, holly, spicebush, dogwood with ferns and other herbaceous species in understory, including the rare small whorled pogonia (*Isotria medeoloides*). Much of the native Coastal Plain mixed hardwood forests have been converted to loblolly pine plantations. Large, contingous areas of native forest will require significant restoration actions.

Bald Cypress – Tupelo Swamps *(adapted from Fleming et al. 2006)*
Forests in this group occupy seasonally to semipermanently flooded backswamps, sloughs, and first bottoms of Coastal Plain rivers and streams. These swamp forests occur throughout the Coastal Plain from Delaware south to Florida and west to eastern Texas, and in the Mississippi River alluvial basin north to Kentucky. They are distributed throughout southeastern Virginia, north to Dragon Swamp (Gloucester, King and Queen, and Middlesex Counties). Habitats are deeply flooded (up to 1.3 m) for part of the year; many retain at least some standing water throughout the growing season. Microtopography is often pronounced with small channels, swales, tree-base hummocks, and numerous bald cypress "knees." Overstory composition varies from mixed stands of bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and/or swamp tupelo (*Nyssa biflora*) to nearly pure stands of one species or another. Green ash (*Fraxinus pennsylvanica*), overcup oak (*Quercus lyrata*), American elm (*Ulmus americana*), and red maple (*Acer rubrum*) are occasional overstory associates and frequent understory trees; swamp cottonwood (*Populus heterophylla*) is also an occasional overstory associate and often abundant in disturbed or cut-over stands. A few of the typical herbs are lizard's-tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), and Walter's St. John's-wort (*Triadenum walteri*). Tidal bald cypress forests and woodlands also occur on the Northwest and North Landing River and are more rare than their non-tidal counterparts though similar in terms of composition, the understory being a mix of marsh and swamp vegetation.

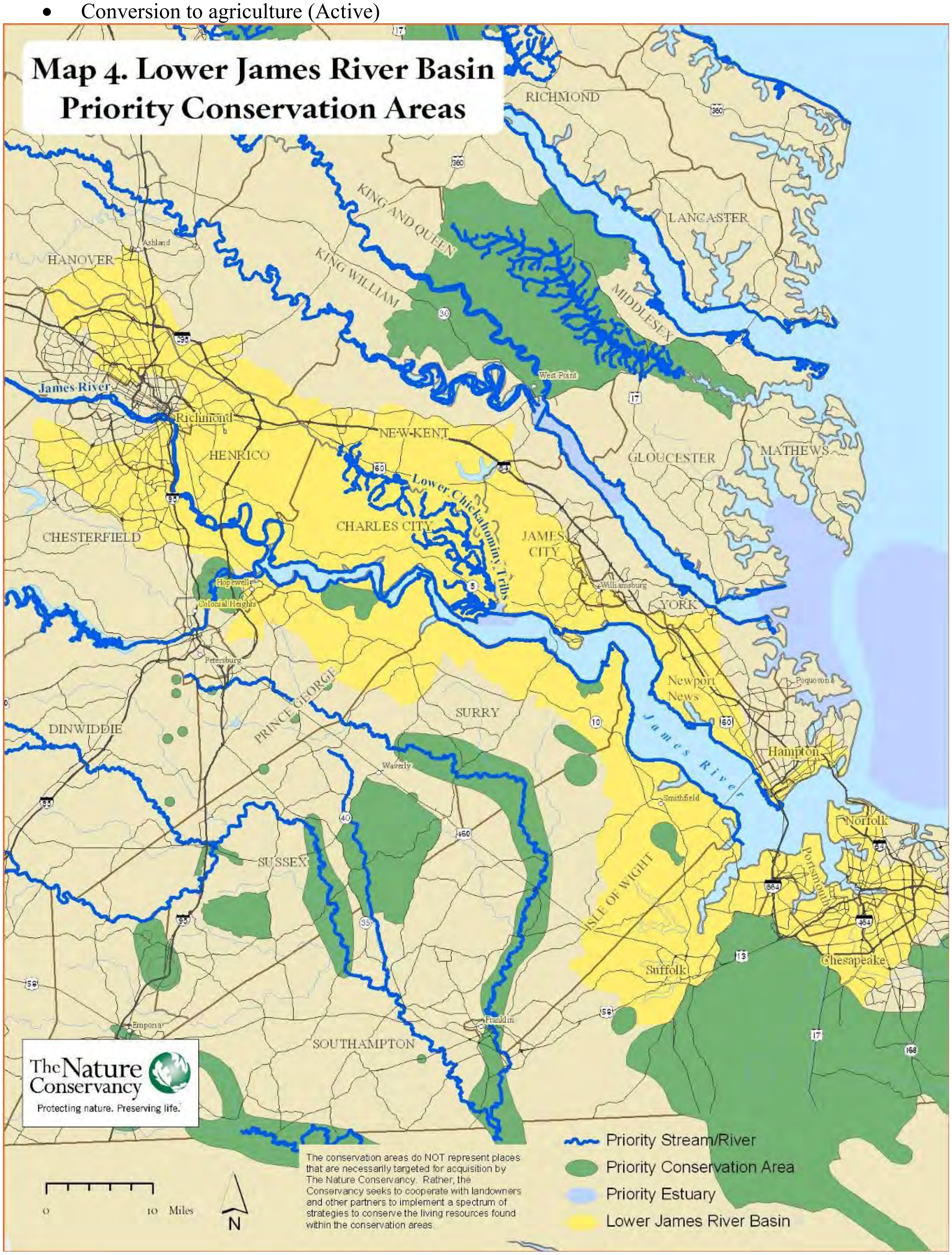
Seepage Wetlands *(adapted from Fleming et al. 2006)*
A mosaic of inter-grading fire-maintained shrub/graminoid-dominated seepage bogs and forested seepage swamps that occur in small patches in areas of dissected topography and sandy/peaty soils in braided seepage streams of small headwaters and toe slopes fed by groundwater. Support rare plant species swamp-pink (*Helonias bullata*) and New Jersey rush (*Juncus caesariensis*) and critical breeding habitat for odonates and amphibian species. Groundwater supports globally rare interstitial gastropods and isopods. Seepage wetlands (particularly the fire-dependent open bogs) are mostly extirpated throughout site due to fire-suppression and hydrological degradation and are in need of significant restoration. Extant occurrences are scattered throughout inner coastal plain and Piedmont.

Diadromous Fishes
Diadromous species migrate between freshwater rivers and streams and continental shelf marine waters by way of the Chesapeake Bay and its major tributaries. These species are either anadromous, fishes that live predominantly in saltwater and move to freshwater to reproduce (e.g. blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengu*), hickory shad *Alosa mediocris*), and American shad (*Alosa sapidissima*)) or catadromous, species that spend the majority of life in freshwater and migrate seaward to spawn (e.g. American eel (*Anguilla rostrata*)). The stress associated with the physiological changes required to transition between fresh and salt water render these species extremely vulnerable to habitat impacts within freshwater and marine migratory corridors, and a majority of their historic freshwater spawning habitat is no longer accessible due to dams and other barriers. These species were all formerly abundant within Chesapeake Bay tributaries, and are now either locally extinct, showing declining trends, or at very low levels.

D. THREATS

- Incompatible residential development
- Global climate change (sea level rise)
- Incompatible forestry practices (silviculture)
- Invasive and/or non-native fish species
- Invasive and/or non-native plant species
- Sea level rise
- Water Management

- Lack of fire
- Fishing (includes boating)
- Dam construction by beavers
- Incompatible crop and forestry practices (inadequate BMPs)
- Structural impediments to fish passage (dams, clogged culverts, etc.)
- Conversion to agriculture (Active)



SERVICE AREA 5. MIDDLE JAMES RIVER

A. DESCRIPTION

The Middle James River Basin is bound by four major river basins: the Shenandoah, Rappahannock and York to the north and the Roanoke and Chowan to the south. The Middle James flows between the Blue Ridge mountains and the Fall Line, through the Piedmont which has scattered hills and small mountains to the west which give way to gently rolling slopes and lower elevation in the eastern Piedmont.

Over 70 percent of the Middle James River Basin is forested, with roughly 18 percent in cropland and pasture. Approximately one percent is considered urban. The population is concentrated in western Richmond and Petersburg with over 650,000 people and the Lynchburg and Charlottesville areas, each with over 100,000 people. All or portions of the following counties and cities lie within the basin: Albemarle, Amelia, Amherst, Appomattox, Augusta, Bedford, Botetourt, Buckingham, Campbell, Charlottesville city, Chesterfield, Colonial Heights city, Cumberland, Dinwiddie, Fluvanna, Goochland, Greene, Hanover, Henrico, Hopewell city, Louisa, Lunenburg, Lynchburg city, Nelson, Nottoway, Orange, Petersburg city, Powhatan, Prince Edward, Prince George, Richmond city, Rockbridge, Rockingham.

B. PRIORITY CONSERVATION AREAS (SEE MAP 5)

Name	Type	Acres	Stream Miles
Ballinger Creek	Aquatic Site		12.95
Appomattox R	Aquatic Site		168.12
South Fork Appomattox R	Aquatic Site		40.27
Big Lickinghole Cr	Aquatic Site		8.37
Buck Mountain Creek	Aquatic Site		2.09
Buffalo R	Aquatic Site		22.90
Bushy R, Briery Cr	Aquatic Site		10.67
Byrd Cr	Aquatic Site		17.88
David Cr	Aquatic Site		5.08
James R	Aquatic Site		348.49
Mainstem James River (Tidal Freshwater Zone)	Aquatic Site		2.65
Mechums R, Moorman R	Aquatic Site		25.07
North R	Aquatic Site		3.20
Pedlar R	Aquatic Site		20.80
Rivanna R, N Fk, Lynch R	Aquatic Site		21.47
Rivianna R, Rivianna R, S Fk	Aquatic Site		44.30
Rivianna R, S Fk	Aquatic Site		36.53
Slate R	Aquatic Site		26.36
Tye R, Piney R	Aquatic Site		37.08
Apple Orchard Mountain	Terrestrial Forest Matrix Block	13622.3	
Beaumont	Terrestrial Forest Matrix Block	50846.1	
Big Levels	Terrestrial Forest Matrix Block	528.8	
Buffalo Station	Terrestrial Forest Matrix Block	40445.0	
Chestnut Mtn.	Terrestrial Forest Matrix Block	41370.3	
Headwaters Of The Nottoway/Falls Of The Nottoway	Terrestrial Forest Matrix Block	29.9	
Macon	Terrestrial Forest Matrix Block	24471.3	
Southern Shendandoah	Terrestrial Forest Matrix Block	69176.2	
Southwest Mtns.	Terrestrial Forest Matrix Block	16007.8	

Name	Type	Acres	Stream Miles
Sugarloaf Mtn./Rockfish/Shields Gap	Terrestrial Forest Matrix Block	108337.0	
Sweathouse Creek	Terrestrial Forest Matrix Block	36289.7	
Ashton Creek Marsh	Terrestrial Non-Matrix Site	246.8	
Farmville Flatwoods	Terrestrial Non-Matrix Site	55.2	
Fine Creek Mills	Terrestrial Non-Matrix Site	75.6	
Fort Lee	Terrestrial Non-Matrix Site	9355.9	
James River Norwood Bluffs	Terrestrial Non-Matrix Site	11.2	
Swift Creek Marshes	Terrestrial Non-Matrix Site	769.4	
Va Powerline Bogs	Terrestrial Non-Matrix Site	49.4	
Warren Riverside	Terrestrial Non-Matrix Site	7.7	
Willis River Basic Slopes	Terrestrial Non-Matrix Site	640.6	

C. Conservation Targets

Small Piedmont Rivers Aquatic System

This aquatic ecological system is defined as fifth and sixth order small rivers in the Piedmont foothills with headwaters in the Blue Ridge that flow over granites and meta-sedimentary bedrock and have neutral water chemistry. This system type is characterized by long pools and riffles with cobble and rubble interspersed by bedrock outcrops. Typical fish communities consist of minnows, sunfishes, catfish, suckers and perches. Where they occur, chub species including bluehead chub (*Nocomis leptocephalus*), bull chub (*Nocomis raneyi*), river chub (*N. micropogon*), and fallfish (*Semotilus corporalis*) are considered keystone species because they build large nests in which many species spawn. Mollusk communities may include the following species: the triangle floater (*Alasmidonta undulata*), creeper (*Strophitus undulatus*), notched rainbow (*Villosa constricta*), eastern elliptio (*Elliptio complanata*), yellow lance (*Elliptio lanceolata*), Carolina lance (*Elliptio angustata*), and northern lance (*Elliptio fisheriana*). In select reaches, rare mussel species including Atlantic pigtoe (*Fusconaia masoni*) and green floater (*Lasmigona subviridis*) may be found. In addition, a variety of mesic forest community types, both upland and alluvial, are found along the banks of small Piedmont river systems.

Piedmont/Blue Ridge Streams and Tributaries Aquatic System

This aquatic ecological system is defined as moderate gradient headwater streams and major tributaries (first through fifth order) flowing over granites with acidic water chemistry. This system type is characterized by boulder, cobble, and bedrock substrata. Headwater tributaries that originate in the higher elevations of the Blue Ridge are higher gradient, flowing over mafic bedrock. System includes the characteristic native fishes, mussels, crayfish, snails and insects supported by these streams and the associated ecological processes and environmental conditions that sustain them. Characteristic warmwater fish communities include several species of minnows, perches, suckers, sculpins, and sunfish and two James drainage endemics: the longfin darter (*Etheostoma longimanum*) and the stripeback darter (*Percina notogramma*). Where they occur, chub species including bluehead chub, bull chub, river chub, and fallfish in addition to the creek chub (*Semotilus atromaculatus*) and cutlip minnows (*Exoglossum maxillingua*), are considered keystone species because they build large nests in which many species spawn. Coldwater low-order mountain headwater reaches contain brook trout (*Salvelinus fontinalis*). Typical mollusks include the notched rainbow (*Villosa constricta*) and creeper (*Strophitus undulatus*) and occasionally the eastern elliptio (*Ellliptio camplanata*) in addition to the rare green floater and James spinymussel. In addition, a variety of mesic forest community types, both upland and alluvial, are found along the banks of Piedmont/Blue Ridge streams and tributaries.

James Spinymussel (*Pleurobema collina*)

Federally-endangered freshwater mussel species long considered endemic in the upper James River drainage; however, recent findings in the upper Roanoke drainage appear to be identical to *P. collina*. This species occurs in streams of moderate gradient and flow on substrates of mixed sand and gravel/cobblestone in “hard” or carbonate rich waters. It is one of three freshwater mussels where prominent spines can be found on juvenile shells in the United States (Hove and Neves 1994). It is a short-term brooder that releases glochidia in summer (late May through early August). Mussels of this species can live to be about 20 years old. The following fish hosts are reported in a study by Hove and Neves (1994) based on findings in the Craig Creek watershed: rosyside dace (*Clinostomus funduloides*), bluehead chub (*Nocomis leptocephalus*), mountain redbelly dace (*Phoxinus oreas*), blacknose dace (*Rhinichthys atratulus*), central stoneroller (*Campostoma anomalum*), rosefin shiner (*Lythrurus ardens*), satinfin shiner (*Cyprinella analostana*), and the swallowtail shiner (*Notropis procne*).

Historically, this species was widespread in the upper James drainage, including the mainsteam of the James River. In addition to the Rivanna and the mainstem James, the species occurred in the Maury River watershed, Craig Creek watershed, Jackson River watershed, Catawba Creek and the Pedlar River (Moser 1990). In the early 1980s, the species was inventoried throughout its range and was found to have a major reduction in distribution. Consequently, it was listed as federally endangered in 1988. Today, it is known from only 16 stream reaches that are concentrated within the upper Rivanna and Craigs Creek watersheds with a good population occurring in Catawba Creek as well (R. Neves, pers. communication).

Inner Piedmont/Northern Blue Ridge Forest Matrix
Characteristic matrix of sub-xeric to mesic upland mixed hardwood forests that occur throughout the eastern slope of the northern Blue Ridge and the inner northern Piedmont. The dominate communities that compose the forest matrix occur on greenstone, part of the Catoctin formation, a dark green metabasalt that weathers soils with high base saturation, ranging from moderately acidic to basic. The most typical forests found on greenstone soils are characterized primarily by tulip poplar (*Liriodendron tulipifera*) which commonly accounts for 60-70% of the canopy. Oaks such as chestnut oak (*Quercus montana*), white oak (*Q. alba*), northern red oak (*Q. rubra*), scarlet oak (*Q. coccinea*) and southern red oak (*Q. falcata*) occur with relative frequency in the canopy, composing 20-30% of the forest. Hickories such as shagbark hickory (*Carya ovata*), red hickory (*C. ovalis*), and pignut hickory (*C. glabra*) co-occur with oaks but to a less extent, occupying on average between 5-10% of the canopy. White ash (*Fraxinus americana*) and black walnut (*Juglans nigra*), while significant, are less frequent canopy components scattered throughout slope forests.

Of the many forest community groups that occur in this forest matrix, the base-rich or ―basic oak-hickory forests" are the most significant. While not appearing lush, these forest types rank among the most species-rich upland forest in Virginia, averaging about 74 species in a 400-square meter plot sample with oftentimes over 100 species, occurring on slopes, ravines and coves (G. Fleming, pers. communication, Fleming et al. 2006). The acidic analog of slope forests (which can also occur on greenstone though more typically will occur on sandstone bedrock) tends to be found on convex, rocky slopes and is characterized by colonial patches of ericaceous shrubs such as mountain laurel (*Kalmia latifolia*) and much lower overall shrub and herbaceous diversity than forests occurring on basic soils.

Occasionally, mixed oak-pine communities including pitch, table mountain, shortleaf and Virginia pines (*Pinus rigida*, *P. pungens*, *P. echinata* and *P. virginiana*), chestnut oaks, and sassafras (*Sassafras albidum*) can be found on dry, exposed mountain slopes usually on southwest facing cliff tops, crests or spur ridges, having thin, rocky soils. Eastern hemlock (*Tsuga canadensis*) forests can be found in higher elevation ravines and riparian zones as well as on isolated forested bluffs. However most hemlocks in the Rivanna watershed have died due to widespread infestation by the hemlock woolly adelgid (*Pseudoscymnus tsugae*). Other less common or small patch forest types are embedded within the forests described above as dictated by soil type, landform, and aspect.

Outcrops, Cliffs and Forested Bluffs
Exposed, sparsely vegetated vertical cliffs, herbaceous and scrub-shrub rock outcrops and forested bluffs that exist as a mosaic or as individual small patch communities. Cliff vegetation occurs on a variety of substrates, including greenstone and granite, and is dominated by lichens with vascular plants occurring only in the crevices and cliff shelves (Fleming et al. 2006). Outcrop barrens of this landscape tend to occur on exposed meta-basalt, mafic or granitic substrate/bedrock with organic mats of variable thickness. Vegetation is characterized by a patchwork of shrub thickets, herbaceous mats, and lithophytic lichens. Forested bluffs consist of many characteristic forest upland communities of the Piedmont and Blue Ridge like slope/cove forests, mixed mesic hardwood forests, basic mesic forests, etc., that often are contiguous with cliffs and outcrops. Cliffs and outcrop barrens are considered naturally rare communities in both the Piedmont and Central Appalachians, providing habitat for unique assemblages of uncommon to rare plants.

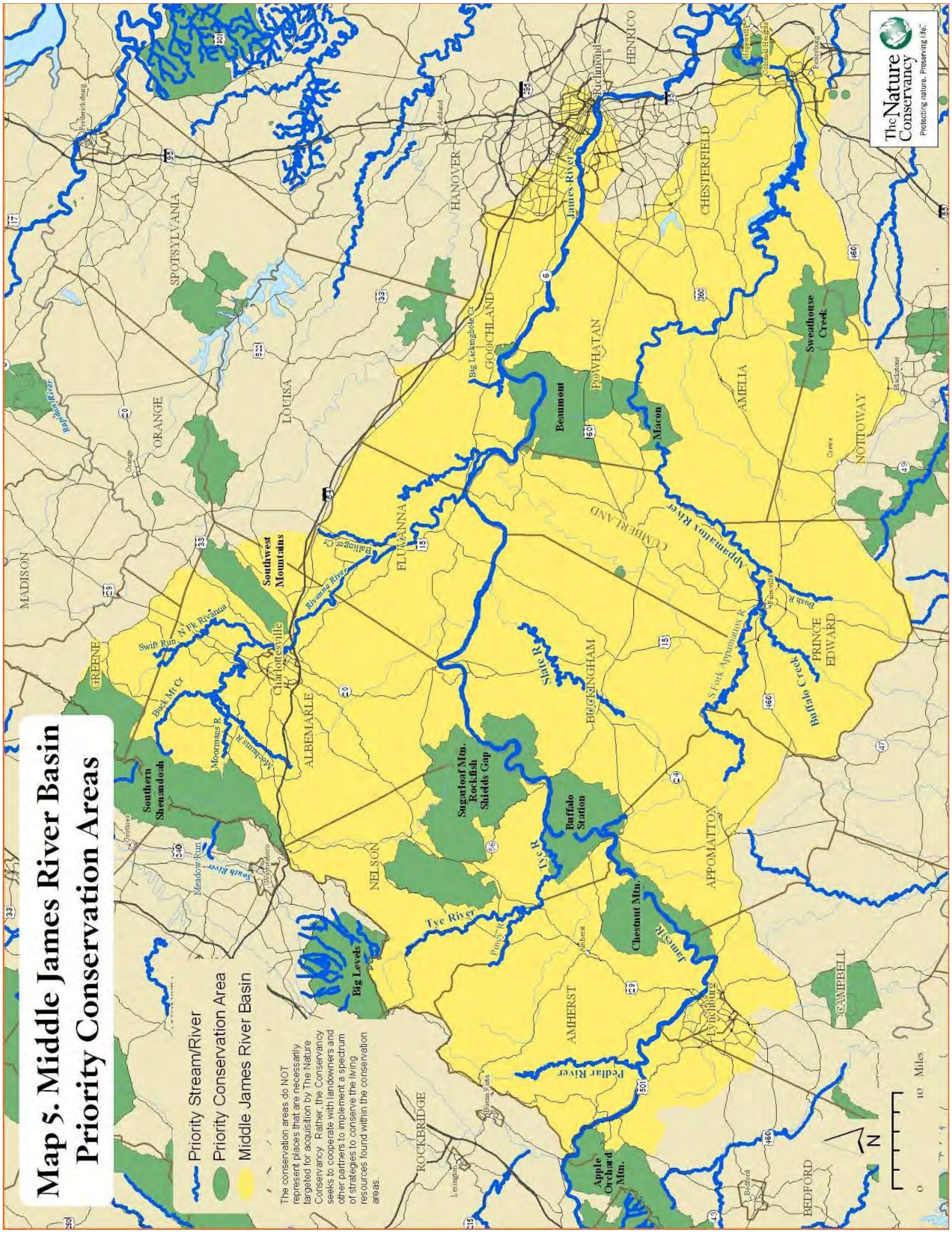
Mountain/ Piedmont Acidic Seepage Swamps *(adapted from Fleming et al. 2006)*

These are saturated deciduous forest swamps found on gentle slopes of seeps and headwater streams at various elevations with extremely acidic soils. Forests are usually dominated by red maple (*Acer rubrum*), blackgum, tulip poplar with a winterberry (*Ilex verticillata*) and ericad shrub layer. Skunk cabbage (*Symplocarpus foetidus*) may be the dominant herbaceous species interspersed with ferns and sedges. These communities are uncommon in the inner Piedmont and Central Appalachians. Seeps are known for their concentrations of uncommon to rare plants and as significant breeding grounds for odonates and habitat for interstitial invertebrates (isopods and amphipods).

Alluvial Floodplain and Swamp Forests *(adapted from Fleming et al. 2006)*
Seasonally flooded to temporarily flooded mixed hardwood forests found along rivers and streams. Swamp forests occur in sloughs and backswamps with clay-rich soils. They are poorly drained forests composed of hydrophytic oaks, green ash (*Fraxinus pennsylvanica*), red maple, high climbing woody vines, and a rich herbaceous layer characterized by several sedge species. Alluvial floodplain or bottomland forests occur on well-drained terraces and levees and are typically populated by silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), sycamores (*Platanus occidentalis*), elms (*Ulmus* spp.), ash (*Fraxinus* spp.), black walnut (*Juglans nigra*) and birch (*Betula* spp.) trees with spicebush (*Lindera benzoin*) and pawpaw (*Asimina triloba*) often dominant in understory and a variable herbaceous layer. Characteristic ecological groups and associations include Piedmont/Mountain Swamp Forests, Piedmont/Mountain Bottomland Forests, and Piedmont Low Mountain Alluvial Forests. In addition, most extant occurrences are severely degraded due to clearing for pastures, development, aesthetic purposes, and infestation by invasive plant species.

D. THREATS

- Global climate change (air temperature extremes)
- Historical land clearing
- Incompatible development
- Water impoundments and withdrawals
- Invasive, non-native plant species
- Incompatible grazing practices
- Deer overbrowse
- Non-native forest pests/pathogens
- Historical logging
- Incompatible agricultural practices
- Invasive, non-native animal species
- Acid deposition
- Incompatible forestry practices
- Private ponds
- Recreational use
- Point Sources
- Fire exclusion


Map 5. Middle James River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Middle James River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
N
0
10 Miles
The Nature Conservancy
Protecting nature. Preserving life.
MADISON
ORANGE
SPOTSYLVANIA
LOUISA
HANOVER
HENRICO
GREENE
ALBEMARLE
FLUVANNA
GOOCHLAND
POWHATAN
CHESTERFIELD
AMELIA
NOTTOWAY
CUMBERLAND
BUCKINGHAM
PRINCE EDWARD
APPOMATTOX
NELSON
AMHERST
CAMPBELL
BEDFORD
ROCKBRIDGE
Southern Shenandoah
Southwest Mountains
Sugarloaf Mtn. Rockfish Shields Gap
Buffalo Station
Beaumont
Macon
Sweathouse Creek
Chestnut Mtn.
Big Levels
Apple Orchard Mtn.
James River
Rivanna River
Appomattox River
Tye River
Pedlar River
Slate R
Buffalo Creek
Bush R
S Fork Appomattox R
Moormans R
Mechums R
Buck Mt Cr
Swift Run
N Fk Rivanna
Ballinger Cr
Big Lickinghole Cr
Piney R
Meadow Run
South River
Rapidan River
Charlottesville
Richmond
Lynchburg
Farmville
Fredericksburg

SERVICE AREA 6. UPPER JAMES RIVER

A. DESCRIPTION

The Upper James River Basin is bounded by the Shenandoah River Basin to the north and the New River and Roanoke basins to the south. The headwaters originate along the Virginia/West Virginia state line beginning in the Alleghany Mountains and flowing in a southeasterly direction. The James is formed by the confluence of the Jackson and Cowpasture Rivers.

The Upper James runs through the Valley and Ridge Province to the Blue Ridge Mountains, an area dominated by narrow ridges and valleys running in a northeast/southwest direction. Over 80 percent of the James River Basin is forested, with over 12 percent in cropland and pasture. Approximately 0.2 percent is considered urban. The Upper James is largely rural and forested with over X% owned by the US Forest Service. All or portions of the following counties and cities lie within the basin: Alleghany, Bath, Buena Vista city, Clifton Forge city, Craig, Highland, Lexington City, and Rockbridge.

B. PRIORITY CONSERVATION AREAS (SEE MAP 6)

Name	Type	Acres	Stream Miles
Barbours Cr	Aquatic Site		7.10
Buffalo Cr, S Buffalo Cr	Aquatic Site		15.99
Bullpasture R, Cowpasture R	Aquatic Site		31.48
Cowpasture R	Aquatic Site		61.16
Craig Cr	Aquatic Site		69.90
Jackson R	Aquatic Site		34.40
James R	Aquatic Site		116.04
Jennings Creek	Aquatic Site		1.18
Jennings Creek Watershed	Aquatic Site		50.24
Johns Cr	Aquatic Site		27.37
Potts Cr	Aquatic Site		41.39
Stuarts Run	Aquatic Site		4.03
Apple Orchard Mountain	Terrestrial Forest Matrix Block	36852.2	
Big Levels	Terrestrial Forest Matrix Block	13767.2	
Cheat Mountain-Upper Greenbrier-Spruce Mtn	Terrestrial Forest Matrix Block	2042.5	
Craigs Creek / Rich Patch Mountain	Terrestrial Forest Matrix Block	156375.0	
Meadow Creek Mountain	Terrestrial Forest Matrix Block	45728.1	
Mountain Lake	Terrestrial Forest Matrix Block	52450.2	
Shenandoah Mt/Cow Knob/Sister Knob	Terrestrial Forest Matrix Block	82895.5	
Warm Springs Mountain	Terrestrial Forest Matrix Block	77124.4	
Black Oak Ridge	Karst Site	465.9	
Blue Spring Creek	Karst Site	5614.8	
Boiling Spring	Karst Site	182.1	
Brushy Mountain/Timber Ridge	Karst Site	22391.1	
Bullpasture Mountain	Karst Site	36266.6	
Cedar Creek	Karst Site	8783.6	
Colliers Creek	Karst Site	22317.3	
Jackson River/Monterey	Karst Site	11760.5	
Jackson River/Rocky Ridge	Karst Site	13525.7	

Name	Type	Acres	Stream Miles
Little Calfpasture River	Karst Site	3138.4	
Maury River	Karst Site	45553.2	
Millboro Springs	Karst Site	80.6	
Nimrod Hall	Karst Site	1080.8	
North Fork Roanoke River	Karst Site	256.3	
Pounding Mill Creek	Karst Site	4017.4	
South Buffalo Creek	Karst Site	11267.6	
The Ridges/Millers Cove	Karst Site	2246.8	

C. CONSERVATION TARGETS

Central Appalachians Mixed Hardwood Forest Matrix
This target includes the characteristic and widespread, largely deciduous mixed oak-hickory, maple or hemlock dominated forest communities occurring across a variety of geologic strata, soils, moisture regimes (excluding xeric), topographic positions, and landforms. Different forest community types are distributed as an interdigitating matrix across the landscape. Drier, less diverse oak hickory forests tend to form large patches on more acidic mountain crests, saddles, and sideslopes. Moister, more fertile and base-rich forests of sugar maple, basswood, ash and poplar with diverse and often lush herbaceous layers occur in coves and ravines. Hemlock forests are found in more acidic gorges and sheltered riparian areas often associated with dense mountain laurel and rhododendron.

Oak forests are threatened by gypsy moth invasions and lack of regeneration. Rich cove and slope forests are threatened by non-native, invasive plants species than other forest community types included in this matrix due to the higher fertility and moisture level of soil. Many of the forests occurring on substrates weathered from dolomite and limestone have been cleared for grazing due to their position on convex, often southwest facing slopes. Eastern hemlock communities, while widespread, are by far the most highly threatened portion of the forest due to the hemlock woolly adelgid, an exotic pathogen that is currently decimating eastern hemlock stands throughout the Appalachians. Associated rare species targets include the variable sedge (*Carex polymorpha*), swordleaf phlox *(Phlox buckleyi*).

Pine-Oak-Heath Woodlands
Fire influenced and/or edaphically limited/drought-prone xerophytic vegetation consisting of variable combinations of pines (*Pinus rigida, P. pungens, P. virginiana)* and oaks (*Quercus ilicifolia, Q. montana, Q. coccinea, Q. stellata)* with several ericaceous shrubs and a sparse herb layer. Occurs on rocky, sandy, shallow nutrient poor soils, often on southwest exposed ridges, convex sideslopes, and clifftops. Pine-oak/heath communities are common in the Central Appalachians but threatened throughout by fire suppression and southern pine beetles. The montane pine barren is a globally rare variant of a pine barren association restricted to high elevations and primarily known from the N. Appalachians. Occurrences on Warm Springs Mountain in Bath County may represent the only known locations for this community in the Virginia mountains. Box huckleberry *(Gaylussacia brachycera)* is a rare plant associated with pine-oak-heath woodlands.

Alluvial Floodplain Forests/Grasslands
This target is defined as temporarily flooded deciduous and mixed deciduous/coniferous forest occurring in narrow floodplains along small streams and rivers in mountain valleys. Forests have variable canopy compositions ranging from associations of box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), sycamore (*Plantanus occidentalis*), black walnut (*Juglans nigra*) and mockernut hickory (Carya tomentosa) (called ―Piedmont/Low Mountain Forests") to types that include tulip tree (*Liriodendron tulipifera*), white pine (*Pinus alba*), eastern hemlock (*Tsuga canadensis*), sycamore and yellow or black birch (*Betula alleghaniensis* and *B. lenta*) (called ―Montane Alluvial Forests") (Fleming et al. 2006). Forests have well developed but variable shrub layer (hop hornbeam and flowering dogwood dominant in the montane type and spice bush (*Lindera benzoin*) and paw-paw (*Asimina triloba*) dominant in low mountain type) and mesophytic herbaceous understory layers. Historically, intermittent natural prairie-like openings of warm season grasses persisted within the low mountain floodplain forest

along the Cowpasture River due to Native American land management practices. Forests and grasslands used to be common along alluvial floodplains throughout the Cowpasture River Valley, but most have been cleared and converted to pasture over the last 300 years or longer. Some of best remaining examples of successional alluvial floodplain forest in the conservation area occur in Douthat State Park.

Outcrops/Barrens/Acidic Woodlands
These small patch communities consist of open herbaceous rock outcrops and prairie-like openings, sparse woodlands of chestnut oak, Virginia pine and red cedar, and shrublands which are edaphically-limited. They occur on southwestern facing aspects, occurring below 3500 ft in elevation on varying substrate from acidic (shale barrens) to calcareous (limestone cliffs) (Fleming et al. 2006). Most barren community associations located in this landscape are globally rare. Shale barrens are endemic to the Central Appalachians. The bulk of shale barren distribution is in Bath and Alleghany counties as well as best and largest known occurrences. Limestone outcrops (cliffs) are obscure and distribution is unknown. Rare species targets associated with outcrops, barrens and acidic woodlands include the shale-barren rock-cress (*Arabis serotina)*, Millboro leatherflower *(Clematis viticaulis*), western wallflower *(Erysimum capitatum var capitatum*), wild chess (*Bromus kalmii*), Olympia marble (*Euchloe olympia*), and the Appalachian grizzled skipper (*Pyrgus wyandot*).

Montane Non-Alluvial Wetlands
Saturated deciduous forested seepage swamps are found on gentle slopes of headwater streams at various elevations with extremely acidic soils. Mountain ponds are seasonally to semi-permanently inundated wetlands found on ridge crests and landslide benches or alluvial fans. These seeps and ponds provide important breeding grounds for odonates and amphibians. Seeps are uncommon wetland communities; found scattered throughout Piedmont and mountain ecoregions. Mountain ponds are very rare communities in the Central Appalachians and other mountainous ecoregions. The Federally Endangered northeastern bulrush *(Scirpus ancistrochaetus*) occurs in montane non-alluvial wetlands.

Cave Invertebrate Communities
Obligate cave aquatic organisms (or —stygobites") include isopods and amphipods and obligate cave terrestrial organisms (or —troglobites") include springtails, centipedes, psuedoscorpions, mites, spiders, and beetles. These subterranean invertebrates occur in Siluro-Devonian limestone solution caves, sinkholes, epikarst, springs, intermittent streams and groundwater aquifers. Endemic and globally rare invertebrate species occur in karst systems of Bath and Highland counties. These species include the crossroads cave beetle (*Pseudanophthalmus intersectus*), Vandel's cave isopod (*Caecidotea vandeli*), Burnsville Cove cave amphipod (*Stygobromus conradi*), Morrison's cave amphipod (*S. morrisoni*), Bath County cave amphipod (*S. mundus*). In the Central Appalachians, Bath County is second to Greenbrier County, West Virginia and Lee County, Virginia for subterranean biodiversity, and has comparable levels of endemism.

Bats
Bat species that winter and forage in the conservation area, including the little brown bats (*Myotis lucifugus*), big brown bats (*Eptesicus fuscus*), pipistrels (*Pipistrellus subflavus*), the small-footed myotis (*Myotis leibii*), and the federally-listed Indiana bat (*Myotis sodalis*). The Cowpasture watershed represents the easternmost edge of the Indiana bats' range. The world's largest hibernaculum for the Virginia big-eared bat lies just to the north in Hellhole Cave, Pendleton County, WV. The caves found in the upper James watershed may provide an important refuge for these bats should something happen to Hellhole, which is being encroached upon by an active limestone quarry.

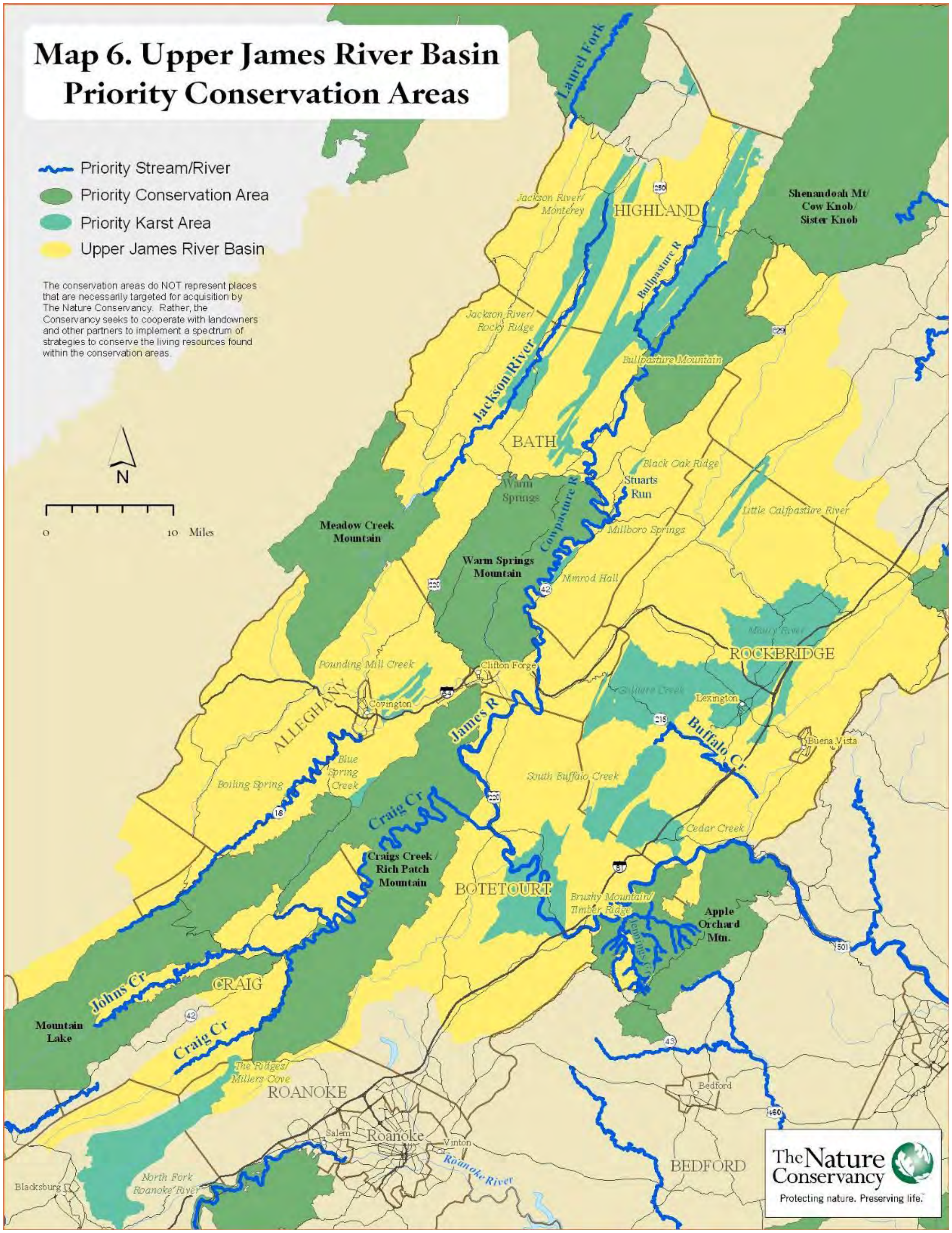
Small Central Appalachian River Aquatic System
This aquatic ecological system is defined as higher order rivers/streams and lower order tributaries in Ridge and Valley topography with watershed dominated by Devonian shales, sandstones, and some cherty limestones. Low gradient channels occur in moderate elevation shales. Tributaries are moderate to high gradient and flow off moderate/high elevation sandstone/shales ridges. Flow is augmented by good connection to karst groundwater. Many tributaries are subterranean and surface flow is highly intermittent. Fish fauna is a typical Ridge and Valley warmwater assemblage with some species less tolerant of alkaline conditions. This aquatic system type occurs in the New, James, and Potomac River drainages in Virginia and has a high level of endemism. The Cowpasture River is the best remaining example of a small central Appalachian river in the James River Drainage. It is one of the most pristine rivers in the state, with high water quality and healthy, diverse aquatic fauna, including viable

populations of three James River endemic fishes: the roughhead shiner (*Notropis semperasper*), stripeback darter (*Percina notogramma*), longfin darter (*Etheostoma longimanum*), and a species restricted in distribution to the Potomac and James drainages, the Potomac sculpin (*Cottus bairdi*).

In the tributaries, a significant assemblage of fish occur, the most notable being the brook trout (*Salvelinus fontinalis*), including the blacknose dace (*Rhinichthys atratulus*), mottled sculpin (*Cottus bairdi*), torrent sucker (*Thoburnia rhothoeca*), mountain redbelly dace (*Phoxinus oreas*), and the creek chub (*Semotilus atromaculatus*). These lower order, high gradient tributaries are more sensitive to the effects of acid deposition due to the fact they flow over more acid substrate with much lower buffering capacity than the more alkaline waters flowing through the valleys at lower elevations.

D. Threats

- Global climate change (temperature extremes)
- Invasive/non-native plant species
- Non-native forest pests and pathogens
- Incompatible energy extraction and development (natural gas, wind)
- Deer management
- Fire exclusion
- Incompatible development
- Incompatible forestry practices
- Historical logging
- Acid deposition
- Incompatible confined animal feeding operations
- Recreational use
- Incompatible agricultural practices
- Incompatible grazing
- Mining practices
- Inadequate cave gate design
- Acid rock drainage



Map 6. Upper James River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Priority Karst Area
Upper James River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
N
0
10 Miles
Laurel Fork
Jackson River/ Monterey
HIGHLAND
Shenandoah Mt/ Cow Knob/ Sister Knob
Bullpasture R
Jackson River/ Rocky Ridge
Bullpasture Mountain
Jackson River
BATH
Black Oak Ridge
Warm Springs
Stuarts Run
Cowpasture R
Little Calfpasture River
Millboro Springs
Meadow Creek Mountain
Warm Springs Mountain
Nimrod Hall
ROCKBRIDGE
Pounding Mill Creek
Clifton Forge
Covington
Lexington
ALLEGHANY
James R
Buffalo Cr
Buena Vista
Blue Spring Creek
Boiling Spring
South Buffalo Creek
Craig Cr
Cedar Creek
Craigs Creek / Rich Patch Mountain
BOTETOURT
Brushy Mountain/ Timber Ridge
Apple Orchard Mtn.
Johns Cr
CRAIG
Mountain Lake
Craig Cr
The Ridges/ Millers Cove
ROANOKE
Bedford
Salem
Roanoke
Vinton
Roanoke River
BEDFORD
North Fork Roanoke River
Blacksburg
The Nature Conservancy
Protecting nature. Preserving life.

SERVICE AREA 7. YORK RIVER

A. DESCRIPTION

The York River Basin lies in the central and eastern section of Virginia and covers 2,662 square miles or 7 percent of the Commonwealth's total area. It is defined by hydrologic boundaries. The basin is bound by the Rappahannock River Basin to the north and east and the James River Basin to the south and west.

The headwaters of the York River begin in Orange County and flow in a southeasterly direction for approximately 220 miles to its mouth at the Chesapeake Bay. The basin's width varies from five miles at the mouth to 40 miles at its headwaters.

The basin is comprised of the York River and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The York River itself is only about 30 miles in length. The Pamunkey River's major tributaries are the North and South Anna Rivers and the Little River, while the major Mattaponi tributaries are the Matta, Po and Ni Rivers.

Lying in the Piedmont and Coastal Plain physiographic provinces, the basin's topography is characterized by slightly rolling hills at the headwaters or extreme western portion, to gently sloping hills and flat farmland near its mouth. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain. Approximately 65 percent of the land area is forest. Farmland and pasture account for approximately 20 percent of the land area. Approximately 10 percent of the river basin land area is urban.

The 2006 population for the York River Basin was approximately 309,067. The majority of the population is rural and is evenly distributed throughout the basin. The only major city that falls within this basin is a portion of Williamsburg. All or portions of the following twelve counties lie within the basin: Albemarle, Caroline, Gloucester, Goochland, Hanover, James City, King and Queen, King William, Louisa, New Kent, Orange, Spotsylvania, and York.

B. PRIORITY CONSERVATION AREAS (SEE MAP 7)

Name	Type	Acres	Stream Miles
Doctor's Creek/Marracossic Creek	Aquatic Site		137.20
Dragon Run/Piankatank River	Aquatic Site		1.02
Little R	Aquatic Site		35.90
Mainstem Mattaponi River	Aquatic Site		142.53
N Anna R	Aquatic Site		3.57
Newfound R	Aquatic Site		7.50
Pamunkey R	Aquatic Site		49.12
Pamunkey River	Aquatic Site		87.90
Pole Cat Creek	Aquatic Site		90.66
Upper York	Marine/Estuarine Site	25851.0	
A. P. Hill	Terrestrial Forest Matrix Block	24670.3	
Dragon Run	Terrestrial Forest Matrix Block	103396.0	
Lake Anna	Terrestrial Forest Matrix Block	22802.0	
North Anna	Terrestrial Forest Matrix Block	20621.9	
Southwest Mtns.	Terrestrial Forest Matrix Block	2779.7	
Vontay	Terrestrial Forest Matrix Block	17297.5	
Wrights Corner South	Terrestrial Non-Matrix Site	82.2	

C. CONSERVATION TARGETS

Tidal Freshwater Marshes *(adapted from Fleming et al. 2006)*
This is a diverse group of herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of inner Coastal Plain rivers and tributaries. In Virginia, tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. Strictly speaking, freshwater conditions have salt concentrations < 0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (*Peltandra virginica*) dotted smartweed (*Polygonum punctatum* var. *punctatum*), wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), rice cutgrass (*Leersia oryzoides*), tearthumbs (*Polygonum arifolium* and *Polygonum sagittatum*), and beggar-ticks (especially *Bidens laevis* and *Bidens coronata*). Locally, sweetflag (*Acorus calamus*), waterhemp pigweed (*Amaranthus cannabinus*), marsh senna (*Chamaecrista fasciculata* var. *macrosperma*), and southern wild rice (*Zizaniopsis miliacea*) may form dominance patches. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (*Nuphar advena*), although cryptic submerged aquatic species may also be present.

Tidal freshwater marshes provide the principal habitat for the globally rare plant sensitive joint-vetch (*Aeschynomene virginica*) and are important breeding habitats for a number of birds, *e.g.*, the least bittern (*Ixobrychus exilis*) . Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes.

Coastal Plain Mixed Hardwood Forests
Well-drained upland forests consisting of beech, oaks, hickories, pines and other common hardwood species; drier, acidic variants consist of strong ericad shrub component, little herbaceous cover and overall low species diversity; richer, mesic variants have higher (almost double) species diversity with paw-paw, holly, spicebush, dogwood with ferns and other herbaceous species in understory, including the rare small whorled pogonia (*Isotria medeoloides*). Much of the native Coastal Plain mixed hardwood forests have been converted to loblolly pine plantations. Large, contiguous areas of native forest will require significant restoration actions.

Bald Cypress – Tupelo Swamps *(adapted from Fleming et al. 2006)*
Progression from tidal bald cypress forest/woodlands to non-tidal, seasonally to semi-permanently flooded cypress-gum found primarily along Dragon Run. Non-tidal swamps are seasonally to semi-permanently flooded forest with overstory composition that varies from mixed stands of bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), and/or swamp tupelo (*Nyssa biflora*) to nearly pure stands of one species or another. Green ash (*Fraxinus pennsylvanica*), overcup oak (*Quercus lyrata*), American elm (*Ulmus americana*), and red maple (*Acer rubrum*) are occasional overstory associates and frequent understory trees. A few of the typical herbs are lizard's-tail (*Saururus cernuus*), false nettle (*Boehmeria cylindrica*), and Walter's St. John's-wort (*Triadenum walteri*). Tidal bald cypress forests and woodlands also occur on the lower Dragon and are more rare than their non-tidal counterparts though similar in terms of composition, the understory being a mix of marsh and swamp vegetation.

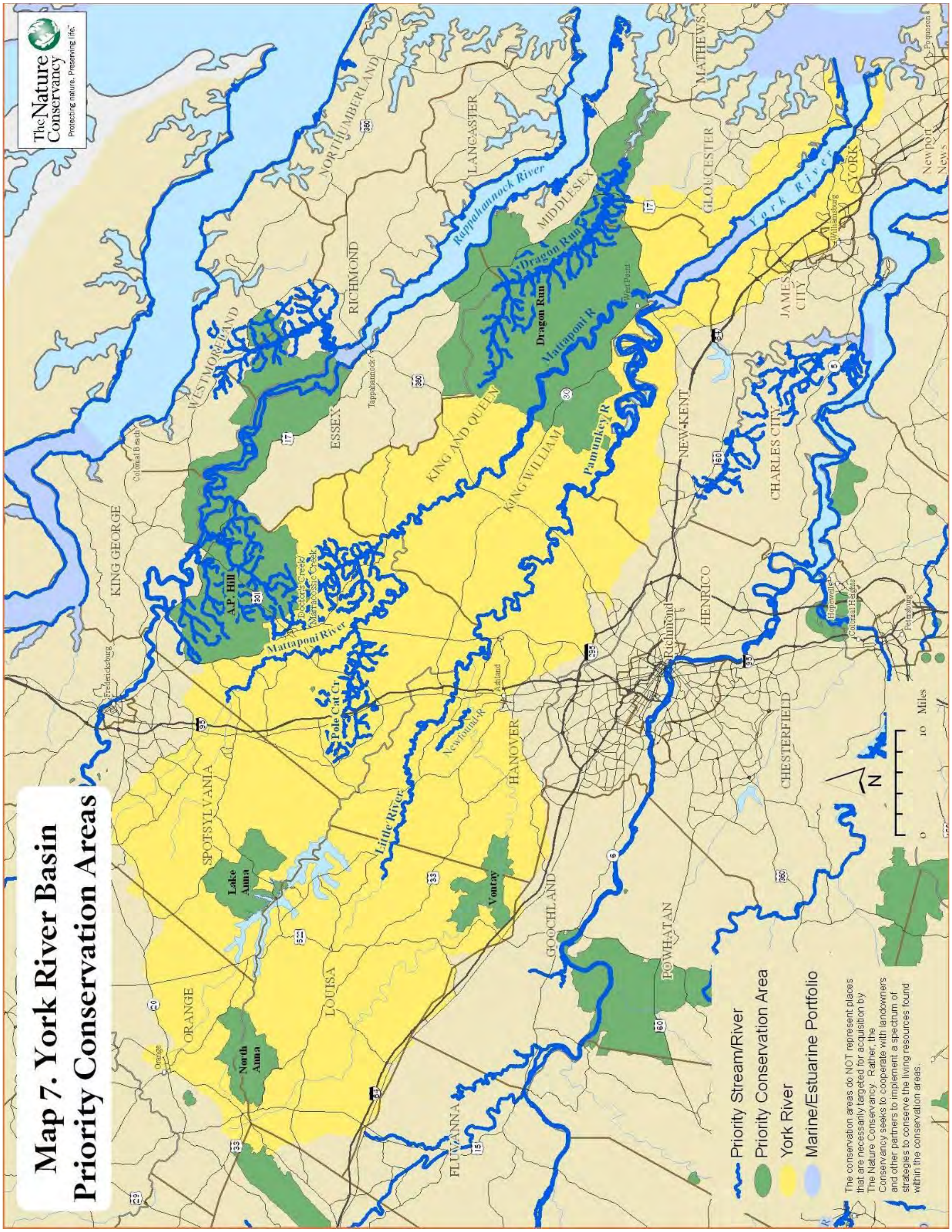
Seepage Wetlands *(adapted from Fleming et al. 2006)*
A mosaic of inter-grading fire-maintained shrub/graminoid-dominated seepage bogs and forested seepage swamps that occur in small patches in areas of dissected topography and sandy/peaty soils in braided seepage streams of small headwaters and toe slopes fed by groundwater throughout the inner Coastal Plain and Piedmont. Support rare plant species such as the Federally Threatened swamp-pink (*Helonias bullata*) and rare New Jersey rush (*Juncus caesariensis*). Provides critical breeding habitat for odonates and amphibian species. Groundwater supports globally rare interstitial gastropods and isopods. Seepage wetlands (particularly the fire-dependent open bogs) are mostly extirpated throughout site due to fire-suppression and hydrological degradation and are in need of significant restoration.

Diadromous Fishes

Diadromous species migrate between freshwater rivers and streams and continental shelf marine waters by way of the Chesapeake Bay and its major tributaries. These species are either anadromous, fishes that live predominantly in saltwater and move to freshwater to reproduce (e.g. blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengu*), hickory shad *Alosa mediocris*), and American shad (*Alosa sapidissima*)) or catadromous, species that spend the majority of life in freshwater and migrate seaward to spawn (e.g. American eel (*Anguilla rostrata*)). The stress associated with the physiological changes required to transition between fresh and salt water render these species extremely vulnerable to habitat impacts within freshwater and marine migratory corridors, and a majority of their historic freshwater spawning habitat is no longer accessible due to dams and other barriers. These species were all formerly abundant within Chesapeake Bay tributaries, and are now either locally extinct, showing declining trends, or at very low levels. The Rappahannock, Mattaponi and Pamunkey watersheds (to Fall Line) maybe last places where all alosine species can still migrate/reproduce successfully without significant habitat impediments or alterations. In these three river systems, the ranges of the target species are found from Chesapeake Bay to upper portions of Chesapeake River watersheds in Piedmont and Blue Ridge.

D. Threats

- Global climate change (sea level rise)
- Incompatible residential development
- Incompatible forestry practices (silviculture)
- Invasive and/or non-native fish species
- Invasive and/or non-native plant species
- Sea level rise
- Water Management
- Lack of fire
- Fishing (includes boating)
- Dam construction by beavers
- Incompatible crop and forestry practices (inadequate BMPs)
- Structural impediments to fish passage (dams, clogged culverts, etc.)
- Conversion to agriculture (Active)



Map 7. York River Basin
Priority Conservation Areas
The Nature Conservancy
Protecting nature. Preserving life.
Priority Stream/River
Priority Conservation Area
York River
Marine/Estuarine Portfolio
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
0
10 Miles
N
KING GEORGE
WESTMORELAND
NORTHUMBERLAND
RICHMOND
LANCASTER
MIDDLESEX
MATHEWS
GLOUCESTER
ESSEX
KING AND QUEEN
KING WILLIAM
NEW KENT
JAMES CITY
YORK
CHARLES CITY
HENRICO
CHESTERFIELD
HANOVER
SPOTSYLVANIA
ORANGE
LOUISA
GOOCHLAND
POWHATAN
FLUVANNA
Rappahannock River
York River
Mattaponi River
Mattaponi R.
Pamunkey R.
Dragon Run
Little River
Pole Cat Cr.
Doctors Creek/
Maracossic Creek
Newfound R.
A.P. Hill
Lake Anna
North Anna
Vontay
Fredericksburg
Tappahannock
West Point
Williamsburg
Richmond
Ashland
Hopewell
Colonial Heights
Petersburg
Colonial Beach
Orange
Newport News
Poquoson

SERVICE AREA 8. POTOMAC RIVER

A. DESCRIPTION

The Potomac River basin headwaters begin in Highland County. The drainage area is 323 square miles for the headwaters. The river then flows in a northeasterly direction through West Virginia and Maryland before joining the Shenandoah at Harper's Ferry, West Virginia. The Potomac continues as the border between Maryland and Virginia. These waters flow approximately 200 miles in a southeasterly direction through Loudoun and Fauquier Counties to eventually Westmoreland County. Approximately 2, 821 of the 14,700 square miles of the Potomac River basin drainage area lie in Virginia. The rest covers four states and the District of Columbia.

Gently sloping hills and valleys from Harpers Ferry to approximately 45 miles down river characterize the topography of the upper Piedmont region of the Potomac River basin. In the central Piedmont area, the profile is rather flat until it nears the fall line at Great Falls, where the stream elevation rapidly descends from over 200 feet to sea level. Tributaries in the central Piedmont exhibit moderate and near constant profiles. Their flat slope largely characterizes streams in the Coastal Plain area. Approximately 40 percent of the Potomac River Basin is forested, 33 percent is farmland and pasture and an estimated 27 percent is urban.

All or part of the following jurisdictions lie within the basin: Counties – Arlington, Fairfax, Fauquier, Frederick, King George, Loudoun, Northumberland, Prince William, Stafford, and Westmoreland; Cities – Alexandria, Fairfax, Falls Church, Manassas, Manassas Park.

B. PRIORITY CONSERVATION AREAS (SEE MAP 8)

Name	Type	Acres	Stream Miles
Goose Creek	Aquatic Site		43.19
Little River	Aquatic Site		7.15
Potomac River	Aquatic Site		267.99
Bull Run Mtns.	Terrestrial Forest Matrix Block	15826.7	
Quantico/Prince William Fp	Terrestrial Forest Matrix Block	40713.1	
Upper Rappahannock	Terrestrial Forest Matrix Block	61.7	
Watery Mtns.	Terrestrial Forest Matrix Block	1728.2	
Aquia Creek Tributary Slopes	Terrestrial Non-Matrix Site	99.6	
Balls Bluff Regional Park	Terrestrial Non-Matrix Site	123.9	
Bull Run Bluffs And Lowlands	Terrestrial Non-Matrix Site	182.8	
Bull Run Diabase Flatwoods	Terrestrial Non-Matrix Site	133.1	
Camp Barrett Ravines	Terrestrial Non-Matrix Site	93.7	
Cannon Creek Grasslands	Terrestrial Non-Matrix Site	22.4	
Carriage Ford	Terrestrial Non-Matrix Site	128.2	
Chestnut Branch	Terrestrial Non-Matrix Site	118.5	
Chopawamsic Creek	Terrestrial Non-Matrix Site	2401.7	
Davids Crossroads Grasslands	Terrestrial Non-Matrix Site	291.1	
Elklick Diabase Flatwoods	Terrestrial Non-Matrix Site	1550.7	
Lower Mount West	Terrestrial Non-Matrix Site	52.4	
Manassas Diabase Uplands	Terrestrial Non-Matrix Site	1832.2	
Nokesville Diabase Flatwoods	Terrestrial Non-Matrix Site	905.0	
Paton Island Shore	Terrestrial Non-Matrix Site	271.9	
Powells Creek Tributary	Terrestrial Non-Matrix Site	39.1	
Russell Road Slopes	Terrestrial Non-Matrix Site	68.9	
Shoals Road	Terrestrial Non-Matrix Site	82.4	
Training Area 16B	Terrestrial Non-Matrix Site	19.1	

Name	Type	Acres	Stream Miles
Upper Mount West	Terrestrial Non-Matrix Site	71.7	
Vulcan Gainesville Tract	Terrestrial Non-Matrix Site	272.4	

C. Conservation Targets

Riparian Communities

Riparian communities are those at lower elevations along the river that flood more frequently (most having a flood return frequency less than 25-30 years, with many less than 2-3 years), and are therefore dominated by species typically associated with floodplains. This conservation target focuses on six globally rare riparian communities that include 25 state rare plant species, and an additional five globally rare and 30 state rare riparian plant species not found within the rare communities.

Terrace Communities

Terrace communities are those at higher elevations along the river that flood less frequently (most having a flood return interval greater than 2-3 years, with many greater than 25-30 years), and are therefore dominated by species typically associated with uplands. This target includes four globally rare terrace communities that include three globally rare and 32 state rare plant species, and ten state rare terrace plant species not found within the rare communities.

Upland Forest Blocks

These forests occur on the uplands and river valley slopes of the Potomac Gorge, in six significant blocks: the Goldmine/Ford Mine Tracts (MD), Riverbend (VA), Great Falls (VA), Turkey Run (two blocks, one on each side of the G.W. Memorial Parkway, VA), and Scotts Run (VA). According to the Virginia ecological community classification, the mid- to late-successional upland forests on the Virginia side represent the following units: Basic Mesic Forests (rich slopes and ravines); Mesic Mixed Hardwood Forests (beech-oak-tulip poplar forests); Eastern Hemlock Forests (Scotts Run); Acidic Oak-Hickory Forests (uplands, widespread); Mixed Oak / Heath Forests (dry, infertile uplands); and Chestnut Oak Forests (rocky bluffs). The upland forest blocks also provide habitat to a number of state rare plant species, as well as bird species that have been identified as conservation priorities by the Partners in Flight (PIF) program.

Rare Groundwater Invertebrates

This target includes four globally rare groundwater-dwelling invertebrates that have been detected at more than 30 springs and seeps within the Potomac Gorge: Potomac groundwater amphipod (*Stygobromus tenuis potomacus*), Pizzini's cave amphipod (*Stygobromus pizzinii*), unnamed amphipod (*Stygobromus* sp. #15), and Appalachian springsnail (*Fontigens bottimeri*). These species are globally or state rare, and they are either endemic or narrowly limited in distribution. The Potomac Gorge is generally regarded as a rich "hotspot" for these fauna, based on the current state of information (Culver, pers. comm., 2001). Their spring and seep habitats are a distinctive natural feature of the Potomac Gorge site, and they harbor unique biological communities. Spring and seeps are very fragile, and they provide an important source of water and minerals for plants and animals. The distinctive habitat of Potomac Gorge groundwater invertebrates, known as "hypotelminorheic," is defined as areas where groundwater seeps to the surface from the underlying bedrock, forming tiny streams or rivulates that flow through leaf litter, loose sediments, and/or vegetation. Maintaining the target species habitat requires protecting portions of upland forest and also helps protect other aquatic invertebrates found in spring/seep/headwater stream (or epigean) habitats, such as copepods, ostracods, gastropods, oliogcheates, planarians, and the larvae of stoneflies, mayflies, and caddisflies. These associated invertebrates are important in the food chain and for maintaining ecological processes such as decomposition and nutrient cycling.

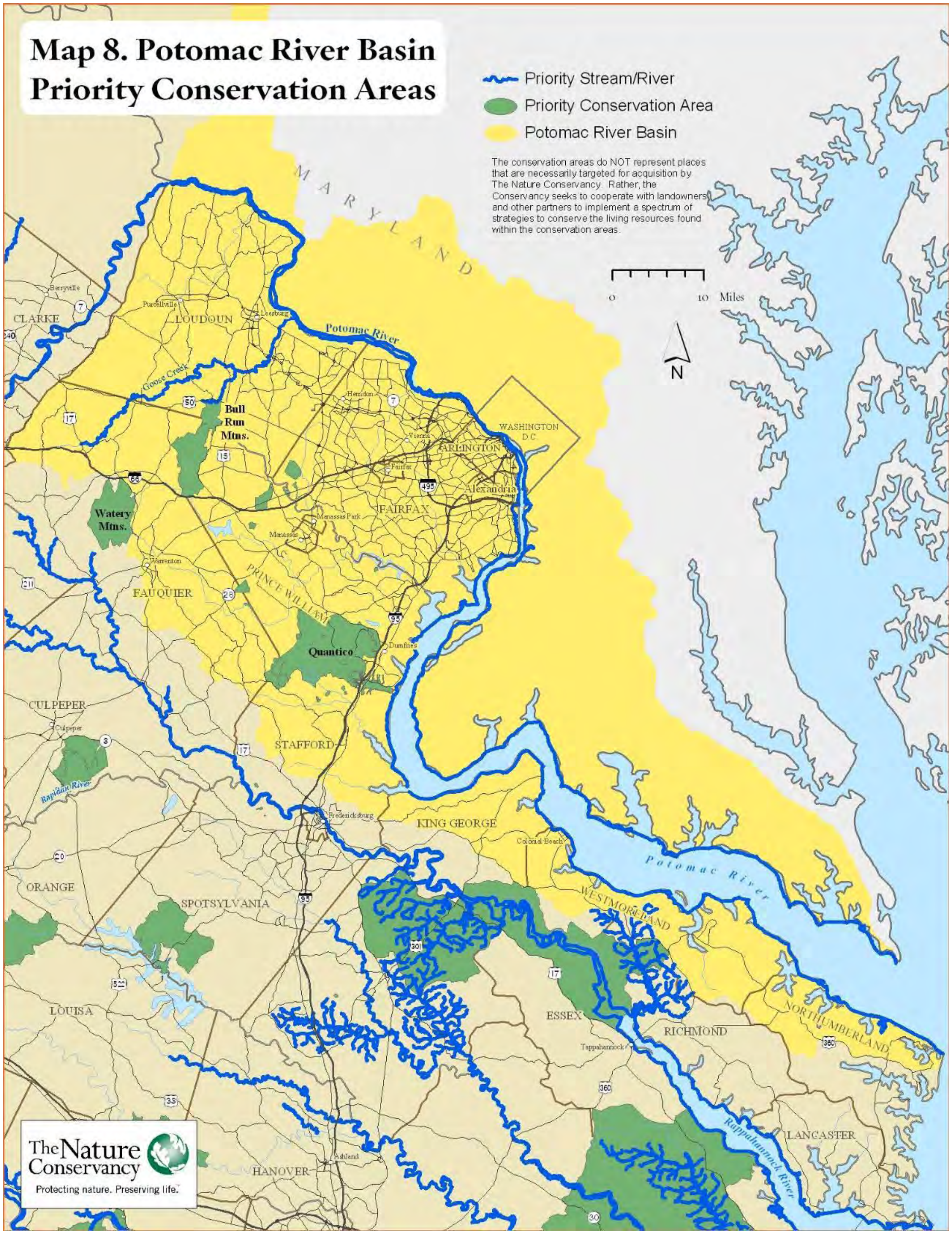
Anadromous/Semianadromous Fish

Anadromous species migrate between freshwater rivers and streams and continental shelf marine waters by way of the Chesapeake Bay and its major tributaries. These species live predominantly in saltwater and move to freshwater to reproduce, e.g. hickory shad (*Alosa mediocris*), American shad (*Alosa sapidissima*)), and striped bass (*Morone saxatilis*)   Semianadromous species such as white perch (*Morone Americana*) follow much the same pattern, but adults stop short of migrating to the sea and instead live in estuaries. These species were all formerly abundant within Chesapeake Bay tributaries, and are now either locally extinct, showing declining trends, or at very low levels. Anadromous/ semianadromous fish in the Potomac River spawn principally in the mainstem at or near the head of tidal influence, and thus are diagnostic for the river in the lower part of the site. They can be considered keystone species here, where their eggs, fry and adults serve as an important food source for other fish and for a variety of invertebrates, birds and mammals.

Mainstem Potomac
The mainstem Potomac River is a large Piedmont river originating in the Blue Ridge and Central Appalachian Mountains with a moderate gradient, warm-water stream ecosystem. It includes a representative Potomac drainage stream fish community (including suckers, darters, minnows and sunfish), a mussel assemblage, and aquatic insect fauna, with some species characteristic of moderate-gradient streams. This ecosystem type occurs in first to third order streams of low- to moderate-gradients, predominantly over granite and meta-sedimentary bedrock. Its waters are mildly acidic and have low turbidity and silt content. The physical habitat is characterized by a pool-riffle sequence with cobble and rubble interspersed with bedrock outcrops.

D. Threats

- Global climate change (air temperature extremes)
- Non-native invasive plants
- Park land development
- Aquatic invasive animals
- Roads/utility corridors
- Incompatible development
- Invasive forest diseases/pathogens
- Municipal water withdrawals
- Water withdrawals upstream for agriculture & power
- Local source sediments, nutrients, and toxins
- Cultural resources (Management of Nature)
- Dams and impoundments
- Overfishing
- Deer


Map 8. Potomac River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Potomac River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
0 10 Miles
N
MARYLAND
Potomac River
LOUDOUN
CLARKE
Bull Run Mtns.
Watery Mtns.
WASHINGTON D.C.
ARLINGTON
Alexandria
FAIRFAX
FAUQUIER
PRINCE WILLIAM
Quantico
CULPEPER
STAFFORD
Rapidan River
KING GEORGE
ORANGE
SPOTSYLVANIA
WESTMORELAND
LOUISA
ESSEX
RICHMOND
NORTHUMBERLAND
LANCASTER
Rappahannock River
HANOVER
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Service Area 9. Shenandoah River

A. Description

The Shenandoah River basin headwaters begin in Augusta County and flow in a northeasterly direction for approximately 100 miles to the West Virginia State line. The basin averages 30 miles in width and covers 2, 926 square miles.

The topography of the Shenandoah River Subbasin is characterized by rolling hills and valleys bordered by the Appalachian Mountains to the west and the Blue Ridge Mountains to the east. The Massanutten Mountain Range divides the Shenandoah River into the North and South Forks. Tributaries of the Shenandoah River exhibit steep profiles as they drain the surrounding mountain ridge. The main stems of the Shenandoah exhibit a moderately sloping profile with occasional riffles and pools. 45 percent of the land is forested due to the large amount of federally owned land and the steep topography. Farmland and pasture account for 39 percent of the land area, while 16 percent is urban.

All or part of the following jurisdictions lie within the basin: Counties –Augusta, Clarke, Frederick, Highland, Page, Rockingham, Shenandoah, Warren; Cities –Harrisonburg, Staunton, Waynesboro, and Winchester.

B. Priority Conservation Areas (see Map 9)

Name	Type	Acres	Stream Miles
Canada Run	Aquatic Site		2.91
Cedar Cr	Aquatic Site		30.27
Coles Run	Aquatic Site		6.75
Dry R, Muddy Creek	Aquatic Site		19.52
Gum Springs Branch	Aquatic Site		1.40
Hawksbill Creek	Aquatic Site		8.67
Johns Run	Aquatic Site		4.87
Laurel Fork	Aquatic Site		15.09
Laurel Run	Aquatic Site		2.07
Loves Run	Aquatic Site		5.02
Middle R, Moffett Cr	Aquatic Site		26.76
Mill Cr	Aquatic Site		7.61
Mills Creek	Aquatic Site		5.92
Mine Branch	Aquatic Site		4.33
Naked Cr	Aquatic Site		3.96
North Fork Back Creek	Aquatic Site		6.12
North R, Briery Branch	Aquatic Site		27.85
Opequon Cr	Aquatic Site		19.85
Orebank Creek	Aquatic Site		3.02
Passage Cr	Aquatic Site		26.92
Pine Run	Aquatic Site		3.38
Shenandoah R	Aquatic Site		109.15
Shenandoah R, N Fk	Aquatic Site		94.55
Shenandoah R, N Fk, Shoemaker R	Aquatic Site		26.75
Shenandoah R, S Fk	Aquatic Site		199.01
Stony Run	Aquatic Site		5.16
Big Levels	Terrestrial Forest Matrix Block	32212.0	
Cheat Mountain-Upper Greenbrier-Spruce Mtn	Terrestrial Forest Matrix Block	28809.9	

Name	Type	Acres	Stream Miles
Northern Shenandoah N.P.	Terrestrial Forest Matrix Block	37265.8	
Shenandoah Mt/Cow Knob/Sister Knob	Terrestrial Forest Matrix Block	199036.0	
Southern Shendandoah	Terrestrial Forest Matrix Block	54683.8	
Brushy Knob	Karst Site	1169.1	
Buffalo Marsh Run	Karst Site	24771.0	
Bullpasture Mountain	Karst Site	787.9	
Church Mountain	Karst Site	5237.7	
Jackson River/Monterey	Karst Site	212.0	
Luray	Karst Site	12219.9	
North Fork Shenandoah/Timberville	Karst Site	49123.3	
Page Valley	Karst Site	9483.6	
Stony Creek/Edinburg	Karst Site	24266.3	
Tide Spring/Daphna Creek	Karst Site	21668.1	
Willow Brook/Happy Creek	Karst Site	11666.9	

C. CONSERVATION TARGETS

Central Appalachians Mixed Hardwood Forest Matrix

This target includes the characteristic and widespread, largely deciduous mixed oak-hickory, maple or hemlock dominated forest communities occurring across a variety of geologic strata, soils, moisture regimes (excluding xeric), topographic positions, and landforms. Different forest community types are distributed as an interdigitating matrix across the landscape. Drier, less diverse oak hickory forests tend to form large patches on more acidic mountain crests, saddles, and sideslopes. Moister, more fertile and base-rich forests of sugar maple, basswood, ash and poplar with diverse and often lush herbaceous layers occur in coves and ravines. Hemlock forests are found in more acidic gorges and sheltered riparian areas often associated with dense mountain laurel and rhododendron.

Oak forests are threatened by gypsy moth invasions and lack of regeneration. Rich cove and slope forests are threatened by non-native, invasive plants species than other forest community types included in this matrix due to the higher fertility and moisture level of soil. Many of the forests occurring on substrates weathered from dolomite and limestone have been cleared for grazing due to their position on convex, often southwest facing slopes. Eastern hemlock communities, while widespread, are by far the most highly threatened portion of the forest due to the hemlock woolly adelgid, an exotic pathogen that is currently decimating eastern hemlock stands throughout the Appalachians. Associated rare species targets include the variable sedge (*Carex polymorpha*), swordleaf phlox *(Phlox buckleyi*).

Northern Blue Ridge Forest Matrix

Characteristic matrix of sub-xeric to mesic upland mixed hardwood forests that occur throughout the eastern slope of the northern Blue Ridge and the inner northern Piedmont. The dominate communities that compose the forest matrix occur on greenstone, part of the Catoctin formation, a dark green metabasalt that weathers soils with high base saturation, ranging from moderately acidic to basic. The most typical forests found on greenstone soils are characterized primarily by tulip poplar (*Liriodendron tulipifera*) which commonly accounts for 60-70% of the canopy. Oaks such as chestnut oak (*Quercus montana*), white oak (*Q. alba*), northern red oak (*Q. rubra*), scarlet oak (*Q. coccinea*) and southern red oak (*Q. falcata*) occur with relative frequency in the canopy, composing 20-30% of the forest. Hickories such as shagbark hickory (*Carya ovata*), red hickory (*C. ovalis*), and pignut hickory (*C. glabra*) co-occur with oaks but to a less extent, occupying on average between 5-10% of the canopy. White ash (*Fraxinus americana*) and black walnut (*Juglans nigra*), while significant, are less frequent canopy components scattered throughout slope forests.

Of the many forest community groups that occur in this forest matrix, the base-rich or ―basic oak-hickory forests" are the most significant. While not appearing lush, these forest types rank among the most species-rich upland forest in Virginia, averaging about 74 species in a 400-square meter plot sample with oftentimes over 100 species, occurring on slopes, ravines and coves (G. Fleming, pers. communication, Fleming et al. 2006). The acidic analog of slope forests (which can also occur on greenstone though more typically will occur on sandstone bedrock) tends to be found on convex, rocky slopes and is characterized by colonial patches of ericaceous shrubs such as mountain laurel (*Kalmia latifolia*) and much lower overall shrub and herbaceous diversity than forests occurring on basic soils.

Occasionally, mixed oak-pine communities including pitch, table mountain, shortleaf and Virginia pines (*Pinus rigida*, *P. pungens*, *P. echinata* and *P. virginiana*), chestnut oaks, and sassafras (*Sassafras albidum*) can be found on dry, exposed mountain slopes usually on southwest facing cliff tops, crests or spur ridges, having thin, rocky soils. Eastern hemlock (*Tsuga canadensis*) forests can be found in higher elevation ravines and riparian zones as well as on isolated forested bluffs. However most hemlocks in the Rivanna watershed have died due to widespread infestation by the hemlock woolly adelgid (*Pseudoscymnus tsugae*). Other less common or small patch forest types are embedded within the forests described above as dictated by soil type, landform, and aspect.

Outcrops/Barrens/Acidic Woodlands

These small patch communities consist of open herbaceous rock outcrops and prairie-like openings, sparse woodlands of chestnut oak, Virginia pine and red cedar, and shrublands which are edaphically-limited. They occur on southwestern facing aspects, occurring below 3500 ft in elevation on varying substrate from acidic (shale barrens) to calcareous (limestone cliffs). Most barren community associations located in this landscape are globally rare. Shale barrens are endemic to the Central Appalachians. The bulk of shale barren distribution is in Bath and Alleghany counties as well as best and largest known occurrences. Limestone outcrops (cliffs) are obscure and distribution is unknown. Rare species targets associated with outcrops, barrens and acidic woodlands include the shale-barren rock-cress (*Arabis serotina)*, Millboro leatherflower *(Clematis viticaulis*), western wallflower *(Erysimum capitatum var capitatum*), wild chess (*Bromus kalmii*), Olympia marble (*Euchloe olympia*), and the Appalachian grizzled skipper (*Pyrgus wyandot*).

Karst Invertebrate Communities

Obligate subterranean invertebrate fauna of Siluro-Devonian limestone solution caves, sinkholes, epikarst, springs, intermittent streams and groundwater aquifers. Obligate cave aquatic organisms (or ―stygobites") include isopods and amphipods and obligate cave terrestrial organisms (or ―troglobites") include springtails, centipedes, psuedoscorpions, mites, spiders, and beetles. Endemic and globally rare invertebrate species occur in karst systems of Augusta, Rockingham, Shenandoah and Frederick counties. These species include the Madison Cave amphipod (*Stygobromus stegerorum*), Hubbard's Cave Beetle (*Pseudanophthalmus hubbardi*), Avernus cave beetle (*Pseudanophthalmus avernus*), and Racovitza's terrestrial cave isopod (*Miktoniscus racovitzae*). Several significant karst systems occur throughout the Shenandoah Valley, notably in the Cedar Creek watershed, along the North Fork of the Shenandoah, South River, Mill Creek and around Willow Brook on the South Fork Shenandoah. Many of the springs and karst related hydrology have been degraded through agricultural run-off of sediments and nutrients.

Montane Non-Alluvial Wetlands (Adapted from Fleming et al. 2006)

This target consists of two ecological groups: calcareous fens and seeps and wet prairies and fens. Calcareous fens and seeps are the more common of the two, characterized by shrubby and herbaceous wetlands of calcareous hillside or foot-slope spring seeps and seepage zones in small stream bottoms. These small-patch wetlands are widely scattered in carbonate rock districts of western Virginia, primarily in valleys of the Ridge and Valley province. The vegetation of these wetlands is often a patch-mosaic of shrubs and herbaceous openings. Common shrubs include willows (*Salix* spp.), smooth alder (*Alnus serrulata*), swamp rose (*Rosa palustris*), alder buckthorn (*Rhamnus alnifolia*), and chokeberries (*Aronia arbutifolia*) and *Aronia prunifolia*). Herbaceous species that are more or less diagnostic of calcareous fens or seeps include several sedges (*Carex* spp.), showy lady's-slipper (*Cypripedium reginae*), small-headed rush (*Juncus brachycephalus*), bog twayblade (*Liparis loeselii*), large-leaved grass-of-parnassus (*Parnassia grandifolia*), swamp lousewort (*Pedicularis lanceolata*), shining ladies'-tresses (*Spiranthes lucida*), and hairlike beakrush (*Rhynchospora capillacea*). The ecological factors that keep fens and seeps open are not well understood, and many examples appear to be threatened by shrub and tree invasion. Ditching, grazing, and introduced weeds are additional threats to these naturally rare wetlands, most of which are unprotected and are high priorities for conservation.

Wet prairies and fens are largely herbaceous wetlands that occur on large stream or river floodplain terraces constantly saturated by perched groundwater or seepage from adjacent slopes. These very rare communities are limited in Virginia to a few sites in valleys of the Ridge and Valley region. Most of the remaining occurrences, two of which are protected, are located along the South River in Augusta County. Vegetation is diverse and generally graminoid-dominated; patch-dominance of sedges (*Carex* spp.), baltic rush (*Juncus balticus* var. *littoralis*), bald spikerush (*Eleocharis erythropoda*), freshwater cordgrass (*Spartina pectinata*), switchgrass (*Panicum virgatum* var. *virgatum*) and, at a single known Virginia site, holy grass (*Hierochloe odorata* ssp. *odorata*) is typical.

Shenandoah Valley Sinkhole Ponds *(adapted from Fleming et al. 2006)*
Intermittently to permanently flooded basin wetlands that occur on broad, acidic alluvial fan deposits along the western foot of the Blue Ridge are colloquially known as Shenandoah Valley Sinkhole Ponds. These wetlands and the geomorphic conditions that have produced their requisite habitats are strictly endemic to a narrow zone that stretches through eastern Augusta, Rockingham, and Page Counties in the central Shenandoah Valley. Here, local solution of deep underlying carbonate rocks and reworking of surficial material by streams have resulted in the development of numerous natural ponds varying in size from less than 0.04 ha (0.1 ac) to over 1.5 ha (3.7 ac). The extraordinary combination of solution features overlain by acidic colluvium and alluvium from metasedimentary rocks of the Blue Ridge has created wetlands with edaphic conditions similar to habitats in the Coastal Plain. Pollen profiles from bottom sediments from two Augusta County ponds demonstrate the continuous existence of wetlands over the past 15,000 years.

Most ponds in the Shenandoah Valley complex experience seasonally fluctuating water levels. The most prevalent, and apparently endemic, community of the Shenandoah Valley ponds is a seasonally flooded vegetation type characterized by scattered pin oak (*Quercus palustris*) and herbaceous species such as warty panic grass (*Panicum verrucosum*), tall flat panic grass (*Panicum rigidulum* var. *rigidulum*), and least spikerush (*Eleocharis acicularis*), which are well adapted to a regime of seasonal flooding and draw-down on mineral soils. The flora of Shenandoah Valley sinkhole ponds is noteworthy for its high percentage of rarities and disjuncts with various biogeographic affinities. Virginia sneezeweed (*Helenium virginicum*) is endemic to these habitats and similar ponds in Missouri, while Virginia quillwort (*Isoetes virginica*) is a state endemic also found in the Piedmont. Northern plants isolated here include toothed flatsedge (*Cyperus dentatus*), slender sedge (*Carex lasiocarpa* var. *americana*), northern St. John's-wort (*Hypericum boreale*), and Torrey's bulrush (*Schoenoplectus torreyi, = Scirpus torreyi*). Swamp-pink (*Helonias virginicum*) (G3) is also found in association with the sinkhole ponds.

These communities are important breeding habitats for amphibians and odonates (dragonflies and damselflies). Although some ponds are located on U.S. Forest Service land, many remain unprotected and threatened by development, hydrologic alterations, off-road vehicles, and trash dumping. Beavers pose an additional threat to these wetlands.

Small Ridge and Valley Streams and Rivers
This conservation target includes three types of aquatic ecological systems:

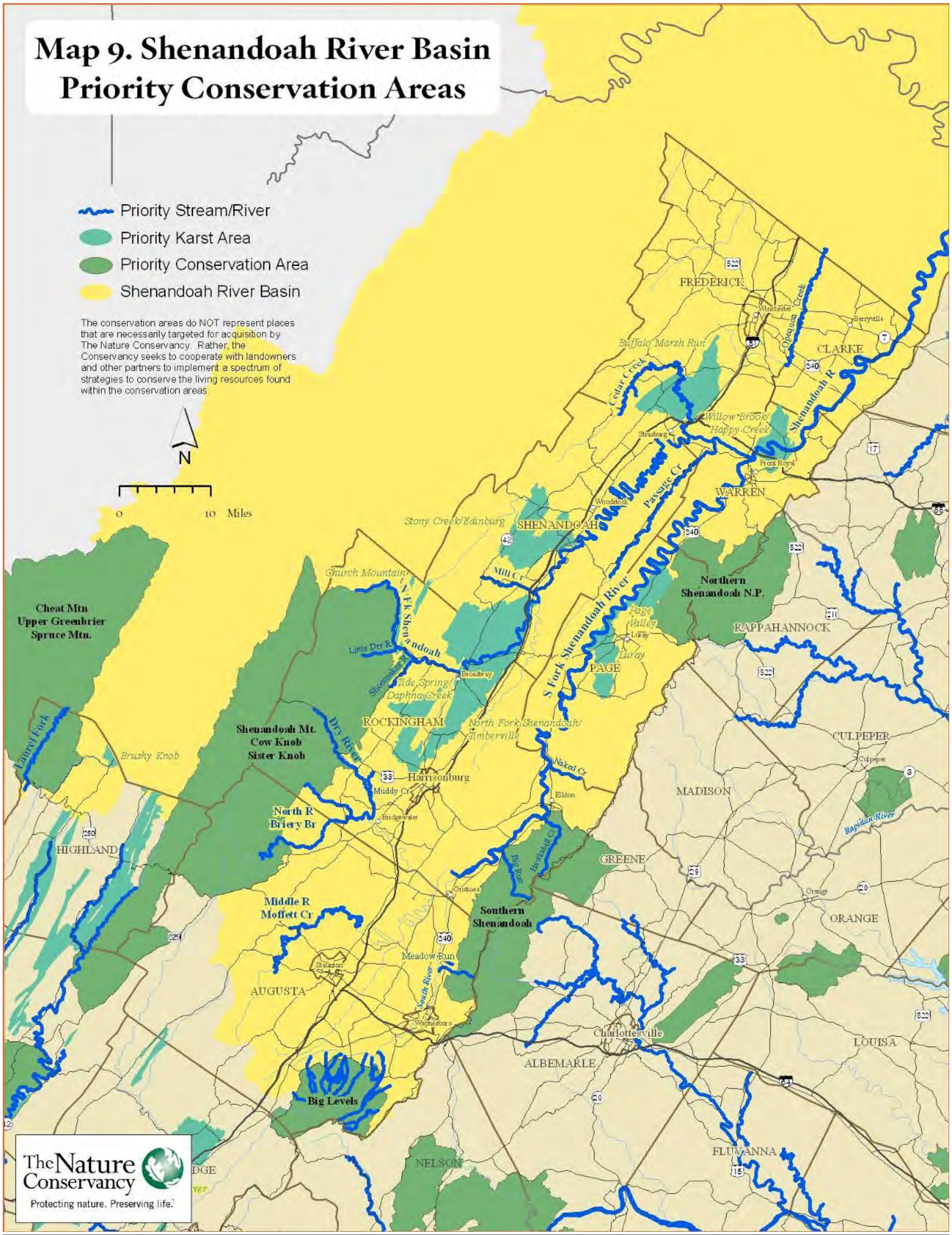
1. Central Appalachians headwaters: Moderate to low elevation dominates with small areas high elevation, acidic shale dominates but also large areas of acidic sedimentary and moderately calcareous veins; landforms dominated by sideslopes. Examples include the North River, Dry River, North Fork Shenandoah.
2. Northern Blue Ridge headwaters: Occur at low to very low elevation on a mixture of acidic sedimentary./metasedimentary acidic shale and moderately calcareous bedrock. Lower tributaries and lowers mainstems occur entirely on calcareous bedrock. Streams flow over landforms dominated by dry flats, wet flats, gentle hills and small areas of sideslopes. Examples include Naked Creek and Hawksbill Creek which fall partly in Shenandoah National Park.
3. Valley floor streams: These occur on low elevation, calcareous sedimentary /metasedimentary acidic shale mixture with calcareous bedrock dominating. Streams flow over landforms dominated by dry flats and wet flats. Examples include Opequon, Mill Creek, and Middle River/Moffett Creek.

Overall, flow in these small rivers and streams is augmented by good connection to karst groundwater. Many tributaries are subterranean and surface flow is highly intermittent. Fish fauna is a typical Ridge and Valley warmwater assemblage, including Fallfish (*Semotilus corporalis*), the swallowtail shiner (*Notropis procne*), and the margined madtom (*Noturus insignis*). Brook trout (*Salvelinus fontinalis*) is a typical cold head water species. According to Jenkins and Burkhead (1994): ―The Shenandoah River system has a montane and upland fauna that basically is typical of other western Chesapeake basin faunas; however, several species unexpectedly are localized or missing….The 58 Shenandoah taxa comprise the catadromous *Anguilla* (American eel), the euryhaline *Fundulus diphanus* (banded killifish), 38 native freshwater species and subspecies, and 18 introduced species."

The water quality, channel structure and riparian buffers of Valley floor streams are severely degraded throughout the Shenandoah by intensive agriculture (primarily confined animal feeding operations and grazing), development, and industrial effluents. In addition, many of the systems have been fragmented due to impoundments.

D. Threats

- Global climate change (temperature extremes)
- Acid deposition
- Incompatible agricultural practices (i.e. confined animal feeding operations)
- Incompatible grazing practices
- Incompatible residential development
- Industrial point sources
- Altered hydrologic flow regimes
- Invasive non-native species
- Impoundments
- Dam construction by beavers



Map 9. Shenandoah River Basin
Priority Conservation Areas
Priority Stream/River
Priority Karst Area
Priority Conservation Area
Shenandoah River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
N
0 10 Miles
FREDERICK
CLARKE
WARREN
SHENANDOAH
PAGE
ROCKINGHAM
HIGHLAND
AUGUSTA
RAPPAHANNOCK
CULPEPER
MADISON
GREENE
ORANGE
ALBEMARLE
LOUISA
FLUVANNA
NELSON
Buffalo Marsh Run
Cedar Creek
Opequon Creek
Shenandoah R
Willow Brook/
Happy Creek
Passage Cr
Stony Creek/Edinburg
Mill Cr
Church Mountain
Northern
Shenandoah N.P.
Cheat Mtn
Upper Greenbrier
Spruce Mtn.
S Fork Shenandoah River
Page Valley
Luray
Little Dry R
Tide Spring/
Daphna Creek
North Fork Shenandoah/
Timberville
Shenandoah Mt.
Cow Knob
Sister Knob
Dry River
Brushy Knob
Laurel Fork
Harrisonburg
Muddy Cr
Naked Cr
Elkton
North R
Briery Br
Big Run
Southern
Shenandoah
Middle R
Moffett Cr
Meadow Run
South River
Staunton
Waynesboro
Charlottesville
Big Levels
Rapidan River
Front Royal
Strasburg
Woodstock
Winchester
Berryville
Broadway
Bridgewater
Grottoes
Culpeper
Orange
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Service Area 10. Rappahannock River

A. Description

The Rappahannock River Basin is located in the northeastern portion of Virginia and covers 2,715 square miles or approximately 6.8 percent of the Commonwealth's total area.

The Rappahannock River Basin is bordered by the Potomac-Shenandoah Basin to the north and the York River Basin and Coastal Basin to the south. The headwaters lie in Fauquier and Rappahannock Counties and flow in a southeasterly direction to its mouth, where it enters the Chesapeake Bay between Lancaster and Middlesex Counties. The Rappahannock River Basin is 184 miles in length and varies in width from 20 to 50 miles. The Rappahannock River Basin's major tributaries are the Hazel River, Thornton River, Mountain Run, Rapidan River, Robinson River, Cat Point Creek, and the Corotoman River.

The topography of the Rappahannock River Basin changes from steep to flat as it flows from the Blue Ridge Mountains to the Chesapeake Bay. About 51 percent of the basin land is forest, while pasture and cropland make up another 36 percent. Only about 6 percent of the land area is considered urban.

Most of the Rappahannock River Basin lies in the eastern Piedmont and Tidewater areas of the Commonwealth while its headwaters, located on the eastern slopes of the Blue Ridge, are considered to be in the northern and western Piedmont section.

The 2006 population of the Rappahannock River Basin was approximately 294,576. The basin is mostly rural in character with no large population centers. However, the basin has seeing increasing urban pressure from the influence of metropolitan Washington in the Fredericksburg and Fauquier areas of the basin. All or portions of the following 16 counties and one city lie within the Basin: Albemarle, Caroline, Culpeper, Essex, Fauquier, Greene, King George, Lancaster, Madison, Middlesex, Orange, Rappahannock, Richmond, Spotsylvania, Stafford, and Westmoreland; Cities- Fredericksburg.

B. Priority Conservation Areas (see Map 10)

Name	Type	Acr	Stream
Cat Point Creek	Aquatic Site		
Fort A.P. Hill Rappahannock River Tribu	Aquatic Site		
Hazel R, Hughes R	Aquatic Site		
Marsh Run	Aquatic Site		
Rappahannock R	Aquatic Site		
Rappahannock R, Hazel R	Aquatic Site		
Rappahannock R, Thumb Run	Aquatic Site		
Thornton R, Rush R	Aquatic Site		
Rappahannock	Marine/Estuarine Site	1	
A. P. Hill	Terrestrial Forest Matrix Block	5	
Culpeper Flatwoods	Terrestrial Forest Matrix Block	1	
Dragon Run	Terrestrial Forest Matrix Block	1	
Northern Shenandoah N.P.	Terrestrial Forest Matrix Block	5	
Southern Shendandoah	Terrestrial Forest Matrix Block		
Southwest Mtns.	Terrestrial Forest Matrix Block		
Upper Rappahannock	Terrestrial Forest Matrix Block	6	
Watery Mtns.	Terrestrial Forest Matrix Block	1	
Horsepen Run	Terrestrial Non-Matrix Site		
Mine Run Ravine	Terrestrial Non-Matrix Site		
Montpelier Forest	Terrestrial Non-Matrix Site		

Name	Type	Acr	Stream
Southern Culpeper Diabase Flatwoods	Terrestrial Non-Matrix Site		
Upper Mine Run Tributary	Terrestrial Non-Matrix Site		

C. CONSERVATION TARGETS

Tidal Freshwater Marshes *(adapted from Fleming et al. 2006)*
This is a diverse group of herbaceous wetlands subject to regular diurnal flooding along the upper tidal reaches of inner Coastal Plain rivers and tributaries. In Virginia, tidal freshwater marshes are best developed on sediments deposited by large meanders of the Pamunkey and Mattaponi Rivers, although outstanding examples also occur along the Potomac, Rappahannock, Chickahominy, and James Rivers. Strictly speaking, freshwater conditions have salt concentrations < 0.5 ppt, but pulses of higher salinity may occur during spring tides or periods of unusually low river discharge. The most common species are arrow-arum (*Peltandra virginica*) dotted smartweed (*Polygonum punctatum* var. *punctatum*), wild rice (*Zizania aquatica* var. *aquatica*), pickerelweed (*Pontederia cordata*), rice cutgrass (*Leersia oryzoides*), tearthumbs (*Polygonum arifolium* and *Polygonum sagittatum*), and beggar-ticks (especially *Bidens laevis* and *Bidens coronata*). Locally, sweetflag (*Acorus calamus*), waterhemp pigweed (*Amaranthus cannabinus*), marsh senna (*Chamaecrista fasciculata* var. *macrosperma*), and southern wild rice (*Zizaniopsis miliacea*) may form dominance patches. Mud flats that are fully exposed only at low tide support nearly monospecific stands of spatterdock (*Nuphar advena*), although cryptic submerged aquatic species may also be present.

Tidal freshwater marshes provide the principal habitat for the globally rare plant sensitive joint-vetch (*Aeschynomene virginica*) and are important breeding habitats for a number of birds, *e.g.*, the least bittern (*Ixobrychus exilis*) . Chronic sea-level rise is advancing the salinity gradient upstream in rivers on the Atlantic Coast, leading to shifts in vegetation composition and the conversion of some tidal freshwater marshes into oligohaline marshes.

Coastal Plain Mixed Hardwood Forests
Well-drained upland forests consisting of beech, oaks, hickories, pines and other common hardwood species; drier, acidic variants consist of strong ericad shrub component, little herbaceous cover and overall low species diversity; richer, mesic variants have higher (almost double) species diversity with paw-paw, holly, spicebush, dogwood with ferns and other herbaceous species in understory, including the rare small whorled pogonia (*Isotria medeoloides*). Much of the native Coastal Plain mixed hardwood forests have been converted to loblolly pine plantations. Large, continguous areas of native forest will require significant restoration actions.

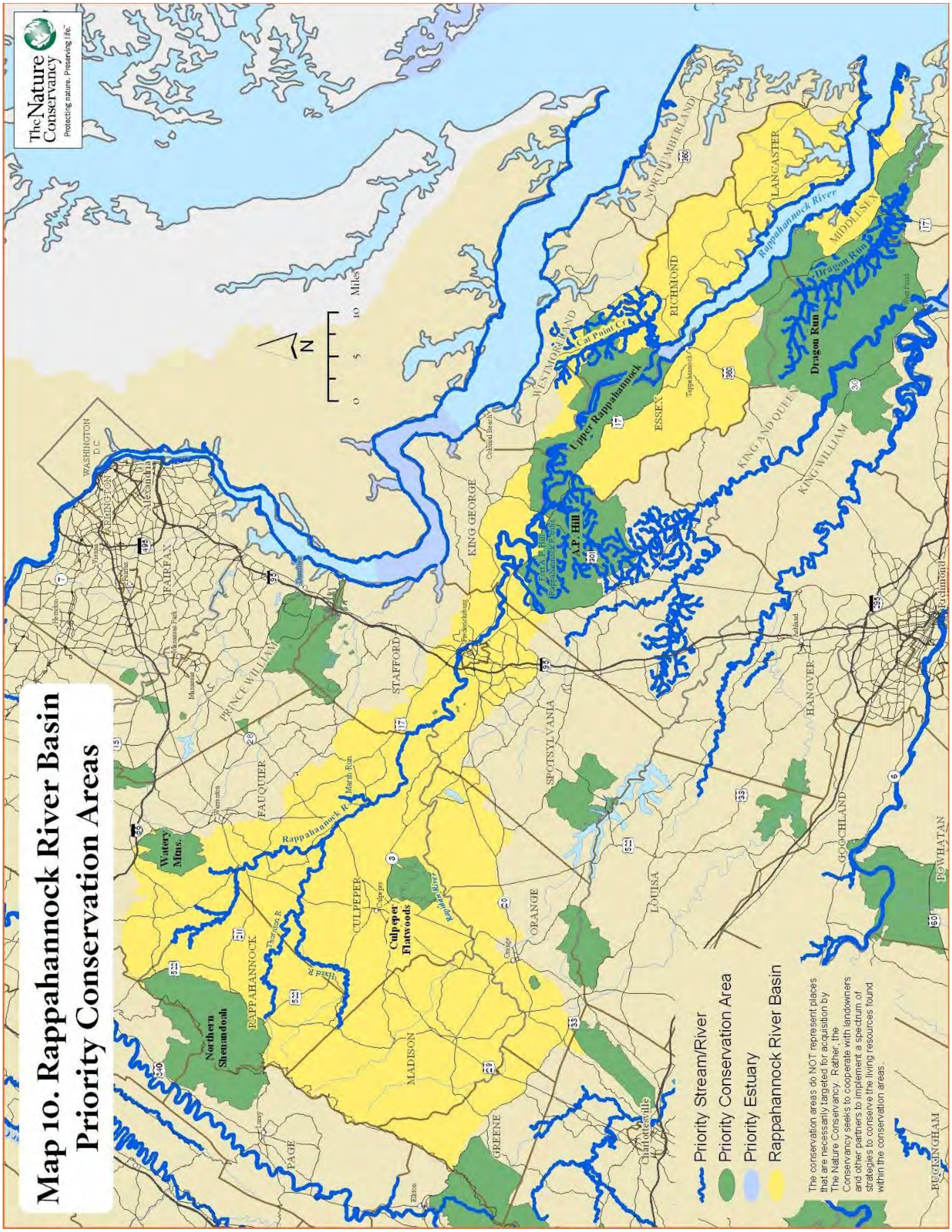
Seepage Wetlands
A mosaic of inter-grading fire-maintained shrub/graminoid-dominated seepage bogs and forested seepage swamps that occur in small patches in areas of dissected topography and sandy/peaty soils in braided seepage streams of small headwaters and toe slopes fed by groundwater throughout the inner Coastal Plain and Piedmont. Support rare plant species such as the Federally Threatened swamp-pink (*Helonias bullata*) and rare New Jersey rush (*Juncus caesariensis*). Provides critical breeding habitat for odonates and amphibian species. Groundwater supports globally rare interstitial gastropods and isopods. Seepage wetlands (particularly the fire-dependent open bogs) are mostly extirpated throughout site due to fire-suppression and hydrological degradation and are in need of significant restoration.

Diadromous Fishes
Diadromous species migrate between freshwater rivers and streams and continental shelf marine waters by way of the Chesapeake Bay and its major tributaries. These species are either anadromous, fishes that live predominantly in saltwater and move to freshwater to reproduce (e.g. blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengu*), hickory shad *Alosa mediocris*), and American shad (*Alosa sapidissima*)) or catadromous, species that spend the majority of life in freshwater and migrate seaward to spawn (e.g. American eel (*Anguilla rostrata*)). The stress associated with the physiological changes required to

transition between fresh and salt water render these species extremely vulnerable to habitat impacts within freshwater and marine migratory corridors, and a majority of their historic freshwater spawning habitat is no longer accessible due to dams and other barriers. These species were all formerly abundant within Chesapeake Bay tributaries, and are now either locally extinct, showing declining trends, or at very low levels. The Rappahannock, Mattaponi and Pamunkey watersheds (to Fall Line) maybe last places where all alosine species can still migrate/reproduce successfully without significant habitat impediments or alterations. In these three river systems, the ranges of the target species are found from Chesapeake Bay to upper portions of Chesapeake River watersheds in Piedmont and Blue Ridge.

D. Threats

- Global climate change (temperature extremes)
- Incompatible residential development
- Incompatible forestry practices (silviculture)
- Invasive and/or non-native fish species
- Invasive and/or non-native plant species
- Sea level rise
- Water Management
- Lack of fire
- Fishing (includes boating)
- Dam construction by beavers
- Incompatible crop and forestry practices (inadequate BMPs)
- Structural impediments to fish passage (dams, clogged culverts, etc.)
- Conversion to agriculture (Active)



Map 10. Rappahannock River Basin
Priority Conservation Areas
The Nature Conservancy
Protecting nature. Preserving life.
Priority Stream/River
Priority Conservation Area
Priority Estuary
Rappahannock River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
0 5 10 Miles
N
Northern Shenandoah
Watery Mtns.
Culpeper Flatwoods
A.P. Hill
Upper Rappahannock
Cat Point Cr.
Dragon Run
Rappahannock River
Rappahannock R.
Rapidan River
Marsh Run
Hazel R.
Thornton R.
WASHINGTON D.C.
ARLINGTON
Alexandria
FAIRFAX
PRINCE WILLIAM
FAUQUIER
STAFFORD
KING GEORGE
WESTMORELAND
NORTHUMBERLAND
LANCASTER
RICHMOND
MIDDLESEX
ESSEX
KING AND QUEEN
KING WILLIAM
CAROLINE
SPOTSYLVANIA
HANOVER
LOUISA
ORANGE
CULPEPER
RAPPAHANNOCK
MADISON
GREENE
PAGE
GOOCHLAND
POWHATAN
BUCKINGHAM
Fredericksburg
Culpeper
Warrenton
Manassas
Charlottesville
Richmond
Ashland
Tappahannock
Colonial Beach
Orange
Luray
Elkton

Service Area 11. New River

A. Description

The New River Basin is located in southwest Virginia and covers 3,070 square miles or approximately 8 percent of the Commonwealth's total land area. The New River flows from its headwaters in Watauga County, North Carolina in a northeasterly direction to Radford, Virginia, and then in a northwesterly direction to Glen Lyn, where it exits into West Virginia. There it flows to the confluence of the Gauley River forming the Kanawha River, a tributary to the Ohio River.

The New River Basin in Virginia is bordered by the James River Basin and Roanoke River Basin to the east, and the Big Sandy River Basin and Tennessee River Basin to the west. The southern boundary of the Virginia portion is the North Carolina State line and its northwest boundary is the West Virginia State line.

The New River Basin runs 115 miles in length from Blowing Rock, North Carolina to Bluestone Dam near Hinton, West Virginia with a maximum basin width of 70 miles near Rural Retreat, Virginia. The Virginia portion of the New River Basin is 87 miles in length.

The topography of the New River Basin is generally rugged; the upper reaches of it tributaries are extremely steep. High mountains, narrow valleys and steep ravines characterize the basin. There are ten tributaries in the Upper New River Basin each having more than 100 square miles in drainage area and many others with forty or more square miles.

The New River Basin is the least densely populated of the Commonwealth's major river basins. The higher elevations of the basin have steep slopes and are thickly forested, while the mount bases are mostly used for agriculture. Approximately 59 percent of its land is forested. Cropland and pasture make up another 35 percent, with approximately 3 percent considered urban.

The 2006 population for the New River Basin was approximately 208,395. All or portions of the following 11 counties lie within the basin: Bland, Carroll, Craig, Floyd, Giles, Grayson, Montgomery, Pulaski, Smyth, Tazewell, Wythe, and the cities of Galax and Radford.

B. Priority Conservation Areas (see Map 11)

Name	Type	Acres	Stream Miles
Burks Fk	Aquatic Site		10.01
Chestnut Cr	Aquatic Site		17.68
Crooked Cr	Aquatic Site		18.70
East R	Aquatic Site		3.40
Fox Cr	Aquatic Site		7.62
Greasy Cr	Aquatic Site		0.01
Laurel Fk	Aquatic Site		6.90
Little Walker Cr	Aquatic Site		16.55
New R	Aquatic Site		205.86
New R, New R, S Fk	Aquatic Site		132.14
Peak Cr	Aquatic Site		36.91
Reed Island Cr	Aquatic Site		32.98
Sinking Creek	Aquatic Site		22.18
Stony Cr	Aquatic Site		8.28
Walker Cr	Aquatic Site		43.02
Walker Cr, Kimberling Cr	Aquatic Site		26.63
Wilson Cr	Aquatic Site		2.34
Wolf Cr, Wolf Cr, Clear Fk	Aquatic Site		50.40

Name	Type	Acres	Stream Miles
Cheat Mountain-Upper Greenbrier-Spruce Mtn	Terrestrial Forest Matrix Block	192.9	
Garden Mountain	Terrestrial Forest Matrix Block	29542.6	
Meadow Creek Mountain	Terrestrial Forest Matrix Block	33.1	
Mountain Lake	Terrestrial Forest Matrix Block	36799.6	
Poor Mountain	Terrestrial Forest Matrix Block	576.6	
Beaver Creek Wetlands	Terrestrial Non-Matrix Site	289.5	
Big Branch	Terrestrial Non-Matrix Site	58.8	
Bog Turtle Macrosite	Terrestrial Non-Matrix Site	8847.8	
Buffalo Mountain	Terrestrial Non-Matrix Site	3782.8	
Camp Creek	Terrestrial Non-Matrix Site	591.9	
Cox Bog	Terrestrial Non-Matrix Site	690.2	
Fisher Peak Wetlands	Terrestrial Non-Matrix Site	410.8	
Hillsville Cranberry	Terrestrial Non-Matrix Site	351.8	
Lower New River	Terrestrial Non-Matrix Site	18932.6	
Max Mountain	Terrestrial Non-Matrix Site	27.9	
Molly Osbourne Shoals	Terrestrial Non-Matrix Site	187.3	
Mt. Rogers	Terrestrial Non-Matrix Site	13467.7	
The Glades	Terrestrial Non-Matrix Site	6708.4	
Willis	Terrestrial Non-Matrix Site	1139.3	
Abbs Valley	Karst Site	4649.9	
Buckeye Mountain/Spruce Run	Karst Site	13308.2	
Burkes Garden	Karst Site	19381.0	
North Fork Roanoke River	Karst Site	723.3	
Pembroke	Karst Site	18178.0	
Radford	Karst Site	25555.3	
Stony Creek/Laurel Branch	Karst Site	5029.8	
Walker Creek East	Karst Site	11090.6	
Walker Creek West	Karst Site	21893.6	
Walker Creek/Sugar Run	Karst Site	32307.4	
Wolf Creek	Karst Site	22838.4	

C. CONSERVATION TARGETS

Southern Blue Ridge Barrens and Balds *(adapted from Fleming et al. 2006)*
Balds constitute a group of globally rare communities restricted to high-elevation (> 5,000 ft) summits and upper slopes in the southern Blue Ridge, from Virginia south to northern Georgia. Dense, shrub-dominated balds are confined in Virginia to high rocky summits in the Mount Rogers - Whitetop Mountain area of Grayson, Smyth, and Washington Counties. At least three vegetation types are present: an evergreen shrubland dominated by Catawba rhododendron (*Rhododendron catawbiense*); a deciduous shrubland dominated by American mountain-ash (*Sorbus americana*), minniebush (*Menziesia pilosa*), and southern mountain-cranberry (*Vaccinium erythrocarpum*); and a deciduous shrubland dominated by Smooth Blackberry (*Rubus canadensis*). Very rocky, cold, windswept habitats probably contribute heavily to the creation and maintenance of shrub balds. In Virginia, Southern Appalachian Grassy Balds are represented by a single occurrence covering approximately 80 ha (200 ac) near the summit of Whitetop Mountain at the convergence of Grayson, Smyth, and Washington Counties.

High-Elevation Outcrop Barrens include scrub and herbaceous vegetation of exposed, metamorphic, igneous, and sedimentary outcrops in the Blue Ridge and, more locally, the Ridge and Valley province. In the northern Blue Ridge, high-elevation outcrop barrens occupy granitic and metabasaltic outcrops of mostly west- to north-facing upper slopes and summits. Vegetation is usually a patchwork of shrub thickets, herbaceous mats, and lithophytic lichens. A number of remarkable, long-range boreal disjuncts, *e.g* ., highland rush (*Juncus trifidus*), Appalachian fir clubmoss (*Huperzia appalachiana*), hemlock parsley (*Conioselinum chinense*), and narrow false-oats (*Trisetum spicatum*), are associated with these outcrops. Community types in this group are considered very rare in Virginia and globally. Threats include trampling and destruction of fragile vegetation mats and invasive introduced weeds such as flat-stemmed bluegrass (*Poa compressa*) and sheep-sorrel (*Rumex acetosella*).

Northern Hardwood Forests *(adapted from Fleming et al. 2006)*
The group consists of mixed hardwood forests occurring at elevations above 1,100 m (3,600 ft) in southwestern Virginia. These forests are endemic to the higher elevations of North Carolina, Tennessee, and Virginia. In the Commonwealth, stands are prevalent throughout the high-elevation Mount Rogers-Whitetop Mountain area of the Blue Ridge (Grayson, Smyth, and Washington Counties), with very local outliers at the highest elevations of the Iron Mountains (Grayson and Smyth Counties), Clinch Mountain (Russell, Smyth, Tazewell, and Washington Counties), and Stone Mountain (Wise County). Co-dominant trees in Southern Appalachian Northern Hardwood Forests are sugar maple (*Acer saccharum* var. *saccharum)*, American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and yellow buckeye (*Aesculus flava*) in variable proportions.

Red Spruce and Fir Forests *(adapted from Fleming et al. 2006)*
Communities of this group are characterized by coniferous and mixed forests with overstory dominance by red spruce (*Picea rubens*) or Fraser fir (*Abies fraseri*). Similar forests occur in the Appalachians from West Virginia south to western North Carolina and eastern Tennessee. Fraser fir forests reach their northern range limit in southwestern Virginia, where they are confined to elevations above 5,400 ft on Mount Rogers in Grayson and Smyth Counties. Habitats are characterized by extremely acidic, organic-rich soils; cold microclimates; high rainfall; frequent fogs; and lush bryophyte cover. Understory layers are sparse, while mountain wood-fern (*Dryopteris campyloptera*) and mountain wood-sorrel (*Oxalis montana*) dominate a relatively dense herb layer. Red spruce (*Picea rubens*) forests similar in composition to those of the North Carolina and Tennessee high mountains are restricted to high-elevation slopes and summits of the Blue Ridge (> 4,300 ft). Southern mountain-cranberry (*Vaccinium erythrocarpum*) and hobblebush (*Viburnum lantanoides*) are often prevalent shrubs in these communities.

Due to their restricted geographic and elevation ranges, all community types in this ecological group are considered globally rare. Red spruce forests provide Virginia's only viable habitats for Weller's salamander (*Plethodon welleri*), and a number of northern migratory birds such as the northern saw-whet owl (*Aegolius acadicus*), hermit thrush (*Catharus guttatus*), magnolia warbler (*Dendroica magnolia*), golden-crowned kinglet (*Regulus satrapa*), red-breasted nuthatch (*Sitta canadensis*), and winter wren (*Troglodytes troglodytes*) that rely on high-elevation coniferous forests for breeding in Virginia. Fraser fir-dominated vegetation is seriously threatened by air pollution and destruction of fir stands by the balsam woolly adelgid (*Adelges piceae*), an introduced insect pest. High elevation spruce-fir forests are threatened by global climate change as well which may extirpate these forest communities in Virginia.

Southern Appalachian Bogs and Fens *(adapted from Fleming et al. 2006)*
Like seepage swamps, communities of this group occupy gently sloping zones of groundwater discharge along valley floors and headwaters streams in the mountain region of Virginia. Stand physiognomy, however, is more open and characterized by saturated woodland, shrubland, and herbaceous vegetation with a dense graminoid component. Bog vegetation is frequently a mosaic of tree or shrub patches and herbaceous openings. Several compositional variants associated with geography and elevation have been documented in Virginia. Species common to most variants include great-laurel (*Rhododendron maximum*), Catawba rhododendron (*Rhododendron catawbiense*), silky willow (*Salix sericea*), smooth alder (*Alnus serrulata*), cinnamon fern (*Osmunda cinnamomea* var. *cinnamomea*), tawny cotton-grass (*Eriophorum virginicum*), Atlantic sedge (*Carex atlantica* ssp. *atlantica*), and brown beakrush (*Rhynchospora capitellata*). The ecological dynamics of these naturally rare communities are not well understood, and many examples are currently suffering from shrub and tree invasions. Factors that may have been

responsible for creating and maintaining open bogs include fire, grazing, beavers, and deep deposition of unstable soils.

Mafic Fens and Seeps are saturated wetlands occurring soils weathered from mafic or ultramafic igneous rocks. Habitats are hillside or foot-slope spring seeps and groundwater-saturated small stream bottoms. The vegetation of these wetlands ranges from open woodlands and tall shrublands to wholly herbaceous, but is often a patch-mosaic of woody growth and herbaceous openings. The herbaceous flora of mafic fens contains many state-rare and unusual species, including several Coastal Plain-mountain disjuncts. The processes that maintain these systems in open condition are poorly understood. All of the documented occurrences are small and have been disturbed to some degree by logging and/or grazing. Ditching and other hydrologic alterations, grazing, non-native weeds, woody succession and, in more open fens, perhaps fire exclusion are continuing threats to these naturally rare wetlands, most of which remain unprotected.

Small Central Appalachian and Blue Ridge Aquatic Systems

Two aquatic systems are considered conservation targets in the New River drainage in Virginia:

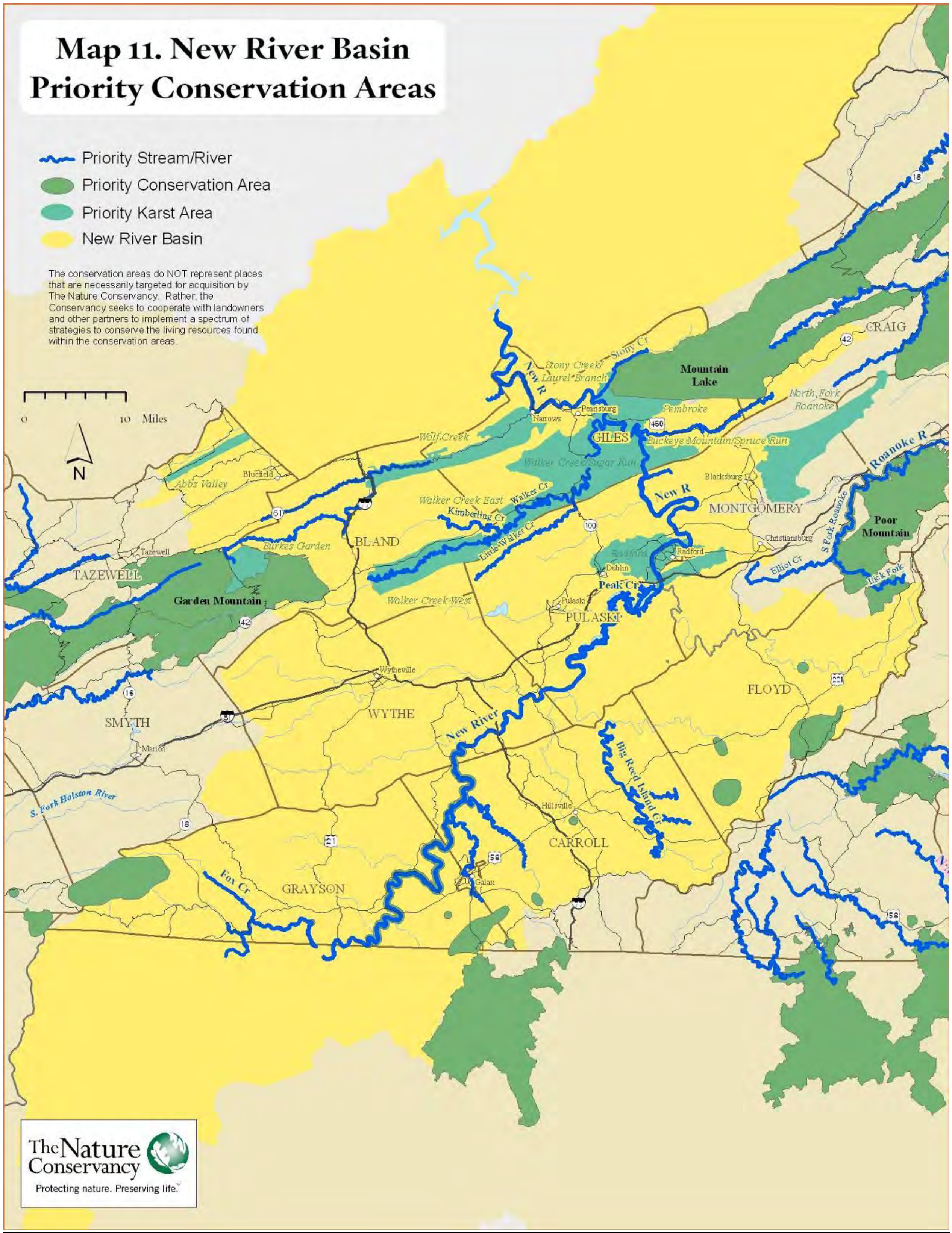
1. Small Central Appalachian aquatic system: Small rivers and streams occurring at primarily moderate elevation with some areas of high elevation, flowing over a complex mixture of calcareous bedrock, moderately calcareous bedrock, acidic shale and acidic sedimentary bedrock. Examples include Little Walker Creek, Walker Creek, Kimberling Creek and Stony Creek.
2. Small Blue Ridge Aquatic system: Headwaters, streams and small rivers occurring at moderate to high elevations on primarily acidic granitic with some acidic sedimentary and very small areas of mafic/intermediate granitic bedrock west of New River mainstem. Examples include headwater streams of the Mount Rogers and Grayson Highlands area such as Wilson Cree, Fox Creek, Big Horse Creek as well lower elevation streams such as Chestnut Creek and Crooked Creek.

While the New River drainage fish fauna is relatively depauperate compared with the James, Roanoke and upper Tennessee drainages, the level of endemism is exceptionally high. A total of eight species are endemic to the New: bigmouth chub (*Nocomis platyrhynchus*), Kanawha minnow (*Phenacobius teretulus*), New River shiner (*Notropis scabriceps*), Bluestone sculpin (*Cottus* sp.), cave sculpin (*Cottus* sp.), and Appalachia darter (P*ercina gymnocephala*), Kanawha darter (*Etheostoma kanawhae*), and the candy darter (*Etheostoma osburni*). Eastern brook trout (*Salvelinus fontinalis*) are common in the high elevation cold water streams. In the Central Appalachian systems, two species of rare mussels, the green floater (*Lasmigona subviridis*) and Tennessee heelsplitter (*Lasmigona holstonia*), have viable populations.

The New River aquatic systems have been severely impacted by major impoundments such as Claytor Lake Dam, grazing, development and PCB and metal contamination. However, some pristine headwater systems occur on public lands, especially Mount Rogers and Grayson Highlands State Park.

D. THREATS

- Incompatible development
- Dams and impoundments
- Incompatible agriculture
- Incompatible grazing
- Toxins and contaminates
- Non-native invasive species


Map 11. New River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Priority Karst Area
New River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
0 10 Miles
N
Mountain Lake
CRAIG
GILES
MONTGOMERY
BLAND
TAZEWELL
Garden Mountain
PULASKI
WYTHE
SMYTH
FLOYD
CARROLL
GRAYSON
Poor Mountain
New River
New R
Walker Creek-Sugar Run
Buckeye Mountain/Spruce Run
Walker Creek East
Walker Creek-West
Burkes Garden
Abbs Valley
Wolf Creek
Pembroke
Stony Creek/Laurel Branch
North Fork Roanoke
Roanoke R
Big Reed Island Cr
Fox Cr
S. Fork Holston River
Peak Cr
Blacksburg
Christiansburg
Radford
Dublin
Pulaski
Wytheville
Marion
Hillsville
Galax
Narrows
Pearisburg
Bluefield
Tazewell
The Nature Conservancy
Protecting nature. Preserving life.

SERVICE AREA 12. ROANOKE RIVER

A. DESCRIPTION

The Roanoke River Basin covers 6,382 square miles or approximately 16 percent of the Commonwealth's total area. The basin is bound by the James River Basin on the east, to the north by the Chowan River Basin, and to the west by the New River Basin. The southern boundary of the basin is the Virginia/North Carolina State line.

The topography of the Roanoke River Basin ranges from steep slopes and valleys in the Valley and Ridge Province to gently sloping terrain east of the mountains in the Piedmont Province.

The Roanoke River Basin headwaters begin in the mountainous terrain of eastern Montgomery County and flow in a southeasterly direction to the Virginia/North Carolina State line. The Roanoke Basin passes through three physiographic provinces- the Valley and Ridge Province to the northwest, and the Blue Ridge and Piedmont Provinces to the southeast.

The Roanoke watershed is large enough to accommodate two major reservoirs, Smith Mountain and Leesville Lakes to the north and Kerr Reservoir and Lake Gaston located at the junction of the Roanoke River and the North Carolina state line. These reservoirs range in size from the 49,000 acre Kerr Reservoir to the 3,400 acre Leesville Lake. These impoundments are used for both recreation and hydroelectricity. Major tributaries in the northern section of the basin are the Little Otter and Big Otter Rivers along with the Blackwater and Pigg Rivers. Major tributaries in the southern portion include the Dan River, Smith River, and Banister River. Over 62 percent of the Roanoke River Basin is forested, while nearly 25 percent is in cropland and pasture. Approximately 10 percent is considered urban.

The 2006 population for the Roanoke River Basin was approximately 690,497. All or portions of the following sixteen counties and five cities lie within the basin: counties – Appomattox, Bedford, Botetourt, Brunswick, Campbell, Carroll, Charlotte, Floyd, Franklin, Halifax, Henry, Mecklenburg, Montgomery, Patrick, Pittsylvania, and Roanoke; cities – Bedford, Danville, Martinsville, Roanoke, and Salem.

B. PRIORITY CONSERVATION AREAS (SEE MAP 12)

Name	Type	Acres	Stream Miles
Big Otter River	Aquatic Site		38.75
Bluestone Creek	Aquatic Site		0.23
Caldwells Creek	Aquatic Site		2.81
Dan River	Aquatic Site		49.82
Elliott Creek	Aquatic Site		9.66
Falling River	Aquatic Site		32.74
Goose Creek	Aquatic Site		40.32
Hookers Creek	Aquatic Site		7.28
Lick Fork	Aquatic Site		8.72
Little Dan River	Aquatic Site		9.91
Mayo River	Aquatic Site		6.05
North Mayo River	Aquatic Site		26.09
North Otter Creek	Aquatic Site		9.01
Overstreet Creek	Aquatic Site		4.43
Peters Creek	Aquatic Site		11.75
Pigg River	Aquatic Site		28.92
Poorhouse Creek	Aquatic Site		7.53
Roanoke River	Aquatic Site		50.87
Rock Castle Creek	Aquatic Site		12.57
Smith Creek	Aquatic Site		4.65

Name	Type	Acres	Stream Miles
Smith River	Aquatic Site		25.76
South Fork Roanoke River	Aquatic Site		17.34
South Mayo River	Aquatic Site		39.62
Apple Orchard Mountain	Terrestrial Forest Matrix Block	21001.6	
Difficult Creek	Terrestrial Forest Matrix Block	36155.9	
Forks Of The Meherrin	Terrestrial Forest Matrix Block	0.6	
Johnson & Smith Mtns.	Terrestrial Forest Matrix Block	59088.0	
Northern Blue Ridge Escarpment	Terrestrial Forest Matrix Block	1111.1	
Poor Mountain	Terrestrial Forest Matrix Block	51362.9	
Seneca Creek	Terrestrial Forest Matrix Block	19920.1	
Smart View	Terrestrial Forest Matrix Block	30046.6	
Thornton Mountain	Terrestrial Forest Matrix Block	20124.8	
Turkeycock Mtn.	Terrestrial Forest Matrix Block	78348.5	
Upper Dan Watershed/Sauratown/Mayo Watershed	Terrestrial Forest Matrix Block	32233.8	
Bald Knob - Rocky Mount	Terrestrial Non-Matrix Site	96.7	
Beaver Pond Creek Flatwoods	Terrestrial Non-Matrix Site	73.4	
Big Otter River North Slope Habitat Zone	Terrestrial Non-Matrix Site	221.4	
Bluestone Slopes	Terrestrial Non-Matrix Site	361.4	
Bog Turtle Macrosite	Terrestrial Non-Matrix Site	1057.2	
Bottom Creek Gorge/S.Fork Roanoke	Terrestrial Non-Matrix Site	10075.1	
Brier Mountain	Terrestrial Non-Matrix Site	1.6	
Buggs Island	Terrestrial Non-Matrix Site	167.0	
Cadwell Creek	Terrestrial Non-Matrix Site	187.3	
Cargills Creek Wildlife Management Area	Terrestrial Non-Matrix Site	74.7	
Cedar Grove Church Flatwoods Habitat Zone	Terrestrial Non-Matrix Site	179.2	
Eagle Point Flatwoods	Terrestrial Non-Matrix Site	44.8	
Eastern Elk Creek Tributary	Terrestrial Non-Matrix Site	0.8	
Elk Creek	Terrestrial Non-Matrix Site	246.3	
Fisher Peak Wetlands	Terrestrial Non-Matrix Site	24.8	
Gasburg Granite Flatrock	Terrestrial Non-Matrix Site	40.8	
Gilbert Mill	Terrestrial Non-Matrix Site	348.6	
Golf Course Granite Flatrock	Terrestrial Non-Matrix Site	19.7	
Grassy Creek Flatwoods	Terrestrial Non-Matrix Site	179.4	
Grassy Hill	Terrestrial Non-Matrix Site	2429.7	
Hogan Creek Flatwoods	Terrestrial Non-Matrix Site	386.4	
Hyco Landing	Terrestrial Non-Matrix Site	106.5	
Hyco River: Us 501 To Rt. 744	Terrestrial Non-Matrix Site	2825.4	
Jacks Creek	Terrestrial Non-Matrix Site	339.6	
Little Spoon Creek	Terrestrial Non-Matrix Site	245.6	
Long Branch	Terrestrial Non-Matrix Site	849.5	
Lower Roanoke (Staunton) River	Terrestrial Non-Matrix Site	5273.1	
Markham Bottomland	Terrestrial Non-Matrix Site	247.9	

Name	Type	Acres	Stream Miles
Panhandle Creek	Terrestrial Non-Matrix Site	246.9	
Peters Creek Central	Terrestrial Non-Matrix Site	336.6	
Peters Creek Tributary At Rt. 660	Terrestrial Non-Matrix Site	79.7	
Rich Creek	Terrestrial Non-Matrix Site	110.7	
Roanoke River Bluff	Terrestrial Non-Matrix Site	98.3	
Sandy Creek	Terrestrial Non-Matrix Site	501.1	
Smith River Rt. 682 Slopes	Terrestrial Non-Matrix Site	88.6	
Spoon Creek	Terrestrial Non-Matrix Site	604.9	
No name	Terrestrial Non-Matrix Site	500.0	
North Fork Roanoke River	Karst Site	27370.6	

C. CONSERVATION TARGETS

Appalachian Acidic Oak-Pine Forest Matrix
This target represents a contiguous matrix of chestnut oak, pine-oak/ heath, montane oak hickory and acidic cove forests that are common and widespread throughout the Appalachians. These forest types all fall on acidic Chilhowee bedrock/formation, occurring on a variety of mountainous landforms with varying aspects and moisture regimes. Oak-hickory forests predominate on richer, sub-mesic slopes, while chestnut oak is found on drier, more infertile soil, pine-oak heath on exposed, xeric ridges and bluffs, and acidic cove forest in mesic, protected coves and gorges. The rare plant species piratebush *(Buckleya distichophylla*) is also associated with these forest.

Basic Mesic Forests *(adapted from Fleming et al. 2006)*
Communities occurring on north-east facing, concave lower slopes and ravines with rich, mesic, calcareous soils along rivers and streams below 2000 ft. Dominant canopy species include sugar maple (*Acer saccharum*), bitternut hickory (*Carya cordiformis*), hackberry (*Celtis occidentalis*), white ash (*Fraxinus Americana*), tulip poplar (*Liriodendron tulipifera*), chinkapin oak (*Quercus muelenbergii*), northern red oak (*Q. rubra*), basswood (*Tilia amercianca*), and slippery elm (*Ulmus rubra)* with an open shrub layer of spice bush (*Lindera benzoin*), pawpaw (*Asimina triloba*), and yellow buckeye (*Aesculus flava*) and a rich, dense herb layer of spring flowering forbs. The rare Addison's leatherflower (*Clematis addisonii)* is associated with these rich forests.

Calcaeous Forest *(adapted from Fleming et al. 2006)*
Submesic to subxeric, well-drained mosaic of open barrens, woodland and forest communities found on limestone/dolomite carbonate formations. Barrens are edaphically limited, occurring on southwest facing slopes with thin soils with a high surface area of exposed bedrock, and characterized by open forb-rich woodlands with stunted trees, intermittent shrubby patches and grass dominated prairie-like openings. Woodlands and forests occur at various aspects on steep, rocky and often convex slopes, summits and ridges between <1000 and 2900 feet in elevation. Characteristic structure appears as a gnarled canopy that includes mixed hardwoods dominated by oaks, sugar maple and ash. This target also includes a more rarified mixed deciduous-coniferous community dominated by northern white cedar, white pine and hemlock on northeast facing aspects. All community types in this group are characterized by high species diversity in the herbaceous layer, including several rare and endemic species. Associated rare species include Addison's leatherflower (*Clematis addisonii*), Cooper's milkvetch (As*tragalus neglectus*), Smooth coneflower (*Echinacea laevigata*), Tall Larkspur *(Delphimium exaltatum*), browneyed Susan (*Rudbeckia triloba* var. *pinnatiloba*), and Canby's mountain-lover (*Paxistima canbyi*).

Calcareous Seeps/Fens *(adapted from Fleming et al. 2006)*
This group includes shrubby and herbaceous wetlands of calcareous hillside or foot-slope spring seeps and seepage zones in small stream bottoms. These small-patch wetlands are widely scattered in carbonate rock districts of western Virginia, primarily in valleys of the Ridge and Valley province. Common shrubs include willows (*Salix* spp.), smooth alder (*Alnus serrulata*), swamp rose (*Rosa palustris*), alder buckthorn (*Rhamnus alnifolia*), and chokeberries (*Aronia arbutifolia* and *Aronia prunifolia*). Herbaceous species that are more or less diagnostic of calcareous fens or seeps include several sedges (*Carex* spp., including the rare Schweinitz's sedge (*Carex*

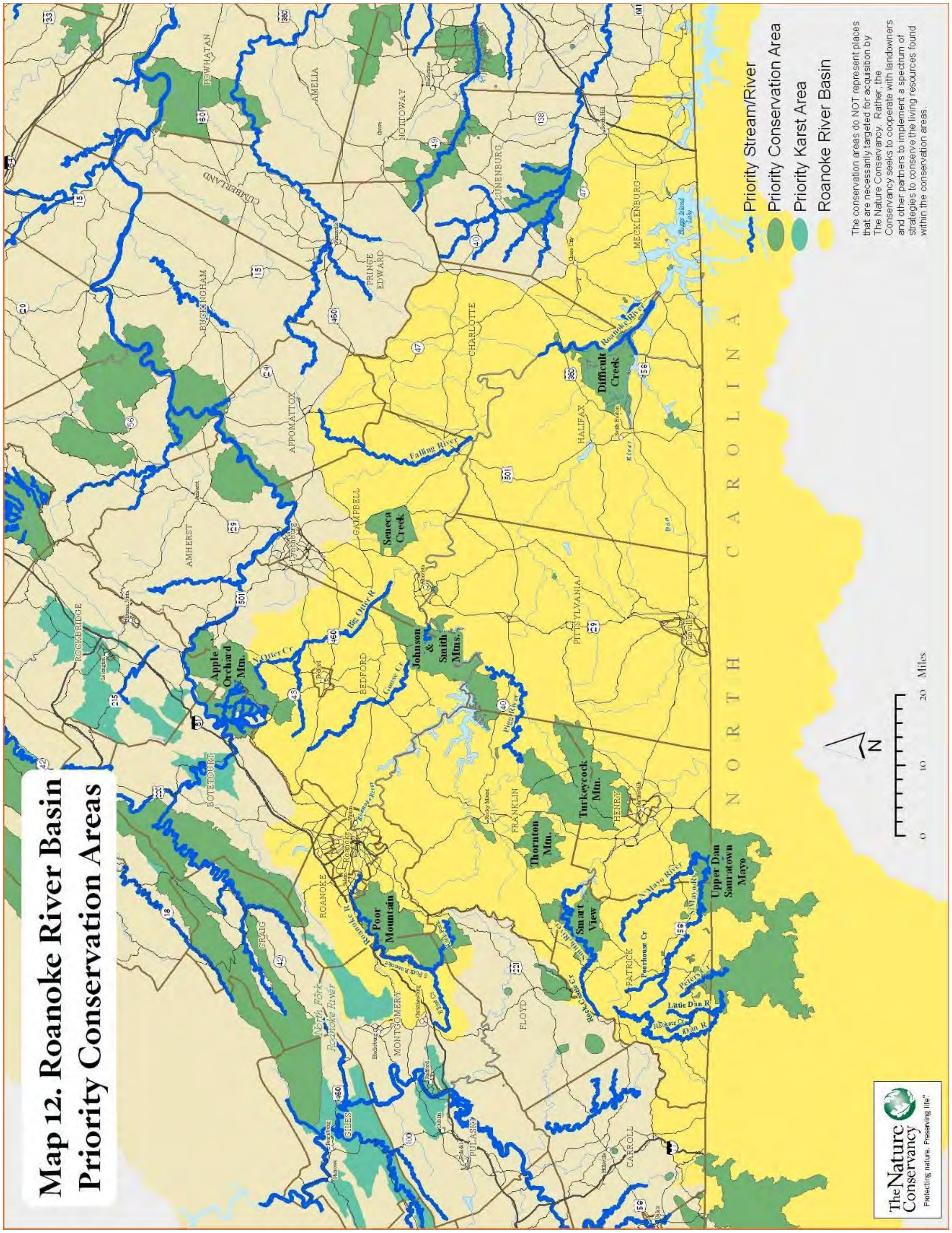
Schweinitzii)), showy lady's-slipper (*Cypripedium reginae*), small-headed rush (*Juncus brachycephalus*), bog twayblade (*Liparis loeselii*), large-leaved grass-of-parnassus (*Parnassia grandifolia*), swamp lousewort (*Pedicularis lanceolata*), shining ladies'-tresses (*Spiranthes lucida*), and hairlike beakrush (*Rhynchospora capillacea*). The ecological factors that keep fens and seeps open are not well understood, and many examples appear to be threatened by shrub and tree invasion. Ditching, grazing, and introduced weeds are additional threats to these naturally rare wetlands, most of which are unprotected and are high priorities for conservation.

Small Ridge and Valley Rivers
This aquatic ecological system is described as moderate gradient rivers (3rd to 5th order), such as the North and South Forks of the Roanoke and mainstem Roanoke, flowing over predominately limestone and calcareous shales, having alkaline/neutral water chemistry. The system is characterized by a pool-riffle sequence with cobble and rubble interspersed by bedrock outcrops. Baseflow comes from groundwater and is stabilized with seasonal flood peaks in spring. Fish communities consist of diverse assemblages of warm water fishes such as suckers, shiners, darters, chubs, dace, minnows and sunfish. There is a very low abundance and diversity of mollusk species.

The upper Roanoke drainage is a meeting ground of the alkaline waters of Central Appalachians and the acidic waters of the Southern Blue Ridge ecoregions. The area is biologically unique due to its diversity of fish species and habitat quality, particularly in the South Fork Roanoke. It is part of the greater the Roanoke drainage which has the highest number of endemic (six species total) fish species on Atlantic Slope while being the third most species rich drainage of the Atlantic Slope. Endemic species include orangefin madtom (*Noturus gilberti*), Roanoke hogsucker (*Hypentelium roanokense*), bigeye jumprock (*Scartomyzon ariommus*), and the riverweed darter (*Etheostoma podostemone*). The Federally Endangered Roanoke logperch (*Percina rex*) has viable populations in the upper Roanoke drainage.

D. THREATS

- Global climate change (temperature extremes)
- Invasive, non-native species
- Incompatible development
- Incompatible grazing practices
- Road construction and improvements
- Incompatible forestry practices
- Deer management
- Forest pests and pathogens
- Acid deposition
- Fire exclusion
- ROW Maintenance
- Ditches, dikes, drainage or diversion systems
- Channelization of rivers or streams
- Excessive groundwater withdrawal
- Dams and reservoirs
- Invasive, non-native fish species



Map 12. Roanoke River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Priority Karst Area
Roanoke River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
N
0 10 20 Miles
NORTH CAROLINA
Apple Orchard Mtn.
Seneca Creek
Johnson & Smith Mtns.
Difficult Creek
Turkeycock Mtn.
Thornton Mtn.
Upper Dan Sauratown Mayo
Smart View
Poor Mountain
ROCKBRIDGE
AMHERST
BUCKINGHAM
CUMBERLAND
POWHATAN
AMELIA
NOTTOWAY
PRINCE EDWARD
APPOMATTOX
CAMPBELL
CHARLOTTE
LUNENBURG
MECKLENBURG
HALIFAX
PITTSYLVANIA
BEDFORD
FRANKLIN
HENRY
PATRICK
FLOYD
CARROLL
PULASKI
MONTGOMERY
GILES
CRAIG
ROANOKE
BOTETOURT
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Service Area 13. Tennessee River

A. Description

The segment of the Tennessee which lies in Virginia is made up of the Holston, Clinch, and Powell watersheds. The upper Tennessee is located in the extreme southwest portion of Virginia and covers 6,687 square miles (including Tennessee portions of the Clinch, Power and Holston).
.

The Virginia portion of the Tennessee-Big Sandy River Basin is defined by both hydrologic and political boundaries. The Kentucky State line lies to the northwest, and Tennessee to the south. The New River Basin makes up the eastern boundary. The southwestward flowing Holston, Clinch, and Powell tributaries form the Tennessee River in Tennessee which eventually empties into the Gulf of Mexico via the Mississippi River.

The upper Tennessee basin crosses three physiographic provinces: the Cumberland Plateau, Valley and Ridge, and the Blue Ridge. Parallel valleys and ridges running in a northeast to southwest direction characterize the Tennessee, lying in the Valley and Ridge Province. A small portion, located in the Blue Ridge Province, is more like a plateau with no single, prominent ridge that characterizes the Ridge and Valley province to the north.

Within Virginia, approximately 48 percent of the Tennessee River Basin is forested, while cropland and pasture make up another 39.7 percent. Urban areas make up only a small percentage of the total land area.

All or parts of the following jurisdictions lie within the basin: counties – Buchanan, Dickinson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe; Cities – Bristol and Norton.

B. Priority Conservation Areas (See Map 13)

Name	Type	Acres	Stream Miles
Beaverdam Creek	Aquatic Site		2.97
Big Moccasin Creek	Aquatic Site		59.67
Blackwater Creek	Aquatic Site		21.52
Clinch River	Aquatic Site		141.36
Copper Creek	Aquatic Site		59.80
Indian Creek	Aquatic Site		12.30
Little River	Aquatic Site		52.57
Lovelady Creek	Aquatic Site		3.36
North Branch Indian Creek	Aquatic Site		2.31
North Fork Clinch River	Aquatic Site		25.43
North Fork Holston River	Aquatic Site		115.70
Possum Creek	Aquatic Site		23.47
Powell River	Aquatic Site		73.52
Black Mountain	Terrestrial Forest Matrix Block	54299.6	
Cleveland	Terrestrial Forest Matrix Block	14052.6	
Clinch Mountain	Terrestrial Forest Matrix Block	183465.0	
Clinch River And Bluffs	Terrestrial Forest Matrix Block	3770.0	

Clinch River Glade Spring Site	Terrestrial Forest Matrix Block	16920.3	
Copper Creek	Terrestrial Forest Matrix Block	11631.0	
Cumberland/Stone Mtn	Terrestrial Forest Matrix Block	24131.5	
Garden Mountain	Terrestrial Forest Matrix Block	33476.5	
High Knob	Terrestrial Forest Matrix Block	81519.7	
Pinnacle	Terrestrial Forest Matrix Block	26851.4	
The Cedars	Terrestrial Forest Matrix Block	26533.4	
Dot Slopes	Terrestrial Non-Matrix Site	1194.2	
Little Stone Mountain	Terrestrial Non-Matrix Site	34.9	
Mt. Rogers	Terrestrial Non-Matrix Site	6748.5	
Rye Cove Karst	Terrestrial Non-Matrix Site	4276.0	
Shady Valley	Terrestrial Non-Matrix Site	1325.3	
Whetstone Branch	Terrestrial Non-Matrix Site	378.3	
Whitetop Laurel Slopes	Terrestrial Non-Matrix Site	460.2	

C. CONSERVATION TARGETS

Endemic Cumberlandian Freshwater Mussels & Associated Assemblage

Freshwater mussels abound in the upper Tennessee River basin, expressing great diversity and ecological viability in the Clinch and Powell rivers. At least 48 species are extant in the Upper Tennessee drainage area (documented within the past 30 years), and many of the globally-rare species' strongest remaining populations are located here. The mussel conservation target is comprised of 31 globally rare mussel species; 18 of which are listed as Federally Endangered with four candidates species. Although dominant species vary by river mile, rainbow mussels (*Villosa iris*), mountain creekshells (*Villosa vanuxemensis*), and Tennessee pigtoes (*Fusconaia barnesiana*) tend to dominate in the headwaters (upper reaches of the river systems); spike (*Elliptio dilatata*), pheasantshells (*Actinonaias pectorosa*), and moccasinshells (*Medionidus conradicus*) dominate the transition zone (middle reaches), and pheasantshells and muckets (*Lampsilis perovalis*) dominate the lower river reaches.

The VNHP has identified 12 significant mussel assemblage concentration sites in the CVP area; 11 of these are located in the Clinch River watershed with nine sites in Copper Creek and two sites in Mill Creek, and one site is located in Wallen Creek along the Powell River. Additionally, we have identified five "priority mussel habitat conservation zones" for this conservation target which represent the "last strongholds" for the mussel conservation target. These priority aquatic habitat zones are McDowell Shoals-Tyler Bend, Swan Island-Sneedville, Kyles Ford-Wallens Bend, Cleveland-Artrip, and Indian Creek-Cedar Bluff.

Data collected by researchers over the past 28 years reveal patterns of decline among globally rare freshwater mussel species in the Powell River and in several significant reaches of the Clinch River (Ahlstedt et al. 2005, Jones pers. comm. 2008). Of the 60 mussel species once documented, at least 11 species that once lived throughout the length of the Clinch River are now considered extinct or extirpated (Ahlstedt 1991). Declines are likely due to excessive sedimentation and altered water quality related to incompatible agriculture, active and legacy mining practices. The FWS Recovery Plan for five endangered mussel species identified stressors to include sedimentation, toxic spills, contaminants, and mineral extraction (USFWS 2004). Another rising concern is the possible threat to aquatic species from contaminant loads bound to sediments or interstitial waters, but very little data exists. A study by the USGS National Water Quality Assessment Program identified elevated levels of polycyclic aromatic hydrocarbons in the Clinch River, from unknown sources (Hampson et al., 2000).

List of endemic Cumberlandian mussels and associated assemblage conservation target species

Scientific Name	Common Name	Global Rank**	Lower	Transi-tional	Head-waters
Cyprogenia stegaria	Fanshell	G1	X		
Dromus dromas	dromedary pearlymussel	G1	X	X	

Scientific Name	Common Name	Global Rank**	Lower	Transi-tional	Head-waters
Epioblasma brevidens	Cumberlandian combshell	G1	X	X	
Epioblasma capsaeformis	oyster mussel	G1	X	X	
Fusconaia cor	shiny pigtoe	G1	X	X	
Fusconaia cuneolus	fine-rayed pigtoe	G1		X	
Hemistena lata	cracking pearlymussel	G1	X		
Lemiox rimosus	birdwing pearlymussel	G1	X	X	
Pegias fibula	littlewing pearlymussel	G1			X
Plethobasus cicatricosus	white wartyback	G1	X		
Pleurobema plenum	rough pigtoe	G1	X		
Quadrula intermedia	Cumberland monkeyface	G1		X	
Quadrula sparsa	Appalachian monkeyface	G1		X	
Villosa perpurpurea	purple bean	G1		X	X
Villosa trabalis	Cumberland bean	G1	X	X	X
Epioblasma florentina walkeri	tan riffleshell	G1T1			X
Lampsilis abrupta	pink mucket	G2	X		
Lexingtonia dolabelloides	slabside pearlymussel	G2	X	X	X
Pleurobema rubrum	pyramid pigtoe	G2	X		
Cumberlandia monodonta	spectaclecase	G2G3	X		
Fusconaia barnesiana	Tennessee pigtoe	G2G3		X	X
Ptychobranchus subtentum	fluted kidneyshell	G2G3	X	X	X
Toxolasma lividus lividus	purple lilliput	G2T1			X
Epioblasma torulosa gubernaculum	green blossom	G2TX	X	X	
Epioblasma triquetra	snuffbox	G2	X		
Fusconaia subrotunda	longsolid	G3	X	X	X
Lasmigona holstonia	Tennessee heelsplitter	G3			X
Plethobasus cyphyus	sheepnose	G3	X	X	
Pleurobema oviforme	Tennessee clubshell	G3	X	X	
Medionidus conradicus	Cumberland moccasinshell	G3G4	X	X	X
Quadrula cylindrica strigillata	rough rabbitsfoot	G3T2	X	X	X?

Global Heritage Status Rank Definitions: **G1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10). **G2 =** Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or linear miles (10 to 50). **G3** = Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals. GX = Presumed Extinct.
The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.

Upper Tennessee Fish Community

In the Upper Tennessee drainage, a relatively healthy fish community is ubiquitous throughout the Clinch, Powell, and North Fork Holston rivers, with faunal diversity generally increasing from upstream to downstream. In general, the fish community of the Upper Tennessee drainage occurs throughout the appropriate river reaches and population levels appear to be within the natural range of variability and the condition appears to be healthy. There have been no known extirpations of species from every watershed in the Upper Tennessee drainage. Diversity can be considered high, when evaluated on the basis of species, feeding guilds, or reproductive guilds. The high diversity of fish in the Upper Tennessee drainage is likely due to the diversity physiography (high rainfall, complex and unglaciated geology and topography), climate, and the historic and recent diversity of aquatic habitat (high gradient streams in mountains and high calcium carbondate in valley streams). Recent data from Tennessee Wildlife Resource Agency, TVA, and VDGIF on the fish fauna of the main-stem rivers yields IBI scores of good or better. The status of the fauna relative to historical conditions is unknown due to a lack of comparable data from earlier times. The following list outlines the 23 fish species that comprise this conservation target.

Upper Tennessee fish community conservation target species (C = Clinch, P = Powell, N = North Fork Holston, S = South Fork Holston, and M = Middle Fork Holston)

Scientific Name	Common Name	Global Rank	River Systems
Erimystax cahni	slender chub	G1	C, P
Etheostoma percnurum	duskytail darter	G1	C
Noturus flavipinnis	yellowfin madtom	G1	C, P
Noturus stanauli	pygmy madtom	G1	C
Phoxinus saylori	Laurel dace	G1	C?
ottus sp. 4	Clinch sculpin	G1G2	C
Cyprinella monacha	turquoise shiner	G2	N
Etheostoma denoncourti	golden darter	G2	C
Percina burtoni	blotchside logperch	G2	C, N
Phoxinus cumberlandensis	blackside dace	G2	P
Etheostoma cinereum	ashy darter	G2G3	C
Ammocrypta clara	western sand darter	G3	C, P
Etheostoma acuticeps	sharphead darter	G3	S
Etheostoma vulneratum	wounded darter	G3	C, P
Notropis ariommus	popeye shiner	G3	C, P, N
Percina macrocephala	longhead darter	G3	C, N
Phoxinus tennesseensis	Tennessee dace	G3	N, M
Acipenser fulvescens	lake sturgeon	G3G4	C
Etheostoma Tippecanoe	Tippecanoe darter	G3G4	
Ichthyomyzon bdellium	Ohio lamprey	G3G4	C, P, N
Ichthyomyzon greeleyi	mountain brook lamprey	G3G4	C, P, N, M
Notropis sp. 4	sawfin shiner	G3G4	C, P, N, S
Phenacobius crassilabrum	fatlips minnow	G3G4	S

Southern Appalachian Forest Matrix

The temperate broadleaf forests of the southern Appalachians are among the most threatened terrestrial major habitat types, and many imperiled species and communities depend upon the larger forest matrix for survival. The Southern Appalachian Forest Matrix is the core terrestrial habitat of the northern portion of the Cumberlands Southern Ridge and Valley ecoregion. These forests provide habitat for most of the terrestrial species of plants and animals that currently or historically occur in the region. The southern Appalachian forest is composed of a range of different natural community types and successional stages. Deciduous trees are the dominant members of the community, with some hemlock in cove areas and pines on dry ridges. Spruce forests occur in special habitats on the highest ridges. The current forest is more homogeneous than desired due to past logging practices, lack of fire, and uncontrolled reversion from agricultural to forestland. The matrix target includes appropriate proportions of the full range of ecological alliances and associations that occur or should occur in the program area.

Isolated Wetlands *(adapted from Fleming et al. 2006)*

The conservation target of Isolated Wetlands refers to 3 ecological community groups, identified by Fleming et al. (2009) as groundwater-controlled, non-alluvial wetlands in the mountain region: (1) calcareous fens and seeps (2) mountain/ piedmont acidic seepage swamps, and (3) inland salt marshes. Brief descriptions of these community groups are provided below.

(1) Calcareous fens and seeps include shrubby and herbaceous wetlands of calcareous hillsides, or foot-slope spring seeps/ seepage zones in small stream bottoms. These small-patch wetlands are widely scattered in the carbonate rock districts of western Virginia, primarily in the valleys of the Ridge and Valley province. Soils, which are typically derived from underlying limestone or dolomite, are slightly - moderately alkaline, with high calcium levels.

(2) Mountain/ piedmont acidic seepage swamps are saturated deciduous forests that occupy gently sloping stream headwaters, large spring seeps, and ravine bottoms with strongly acidic soils of a sandstone, quartzite, or base-poor granite nature. These communities are locally scattered throughout

the Virginia mountains up to about 900m (3,000 ft) elevation. Hummock-and-hollow microtopography, braided streams, areas of coarse gravel and cobble deposition, muck-filled depressions, and abundant *Sphagnum* mats are typical habitat features.

(3) Inland salt marshes are extraordinarily rare communities known in Virginia only from a small mountain valley near Saltville, in Smyth County, Virginia. The unique habitat at Saltville, consisting of seasonally flooded basin wetlands fed by saline springs, has been greatly reduced by industrial salt mining, hydrologic alterations, and grazing. However, small remnant marshes remain, supporting a very rare type of endemic emergent vegetation composed largely of several remarkably disjunct halophytes.

Limestone and Dolomite Barrens *(adapted from Fleming et al. 2006)*

Limestone and Dolomite Barrens community are scattered throughout the western Virginia Ridge and Valley region, usually occurring on steep, south- to west-facing slopes. Communities in this group are highly localized, small-patch units that are considered state-rare and, in some cases, globally rare. These unusual openings in the surrounding forest canopy are characterized by thin, calcareous rocky soils and dominated by native warm season grasses such as Indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), and little bluestem (*Schizochyrium scoparium*). Barren soils typically have high pH (more than 7.0) and calcium levels; in addition, dolomitic soils have relatively high magnesium levels. In addition to warm-season grasses, common associated perennial forbs include: western silky aster (*Symphyotrichum pratense*, = *Aster pratensis*), false boneset (*Brickellia eupatorioides* var. *eupatorioides*), eastern indian-paintbrush (*Castilleja coccinea*), Canada bluets (*Houstonia canadensis*), tall gay-feather (*Liatris aspera* var. *intermedia*), false aloe (*Manfreda virginica*), southern obedient-plant (*Physostegia virginiana* ssp. *praemorsa*), white blue-eyed-grass (*Sisyrinchium albidum*), hairy wild-petunia (*Ruellia humilis*), and stiff goldenrod (*Oligoneuron rigidum* var. *rigidum* = *Solidago rigida* ssp. *rigida*). Stunted trees and shrubs such as chinkapin oak (*Quercus muhlenbergii*), eastern red cedar (*Juniperus virginiana* var. *virginiana*), and Carolina buckthorn (*Frangula caroliniana*) are scattered in the barrens.

Karst Communities

Karst landscapes are characterized by thin soils that develop over easily-dissolved limestone bedrock, creating terrain that tends to be rolling, rocky, rugged, and full of sinkholes, sinking streams, springs and caves. These systems support a diverse array of animals, particularly invertebrates, which comprise the majority of cave ecosystem consumers. Approximately 40% of the Clinch Valley is comprised of karst terrain, where groundwater percolates through sinkholes and karst geology often leading to biologically significant caves.

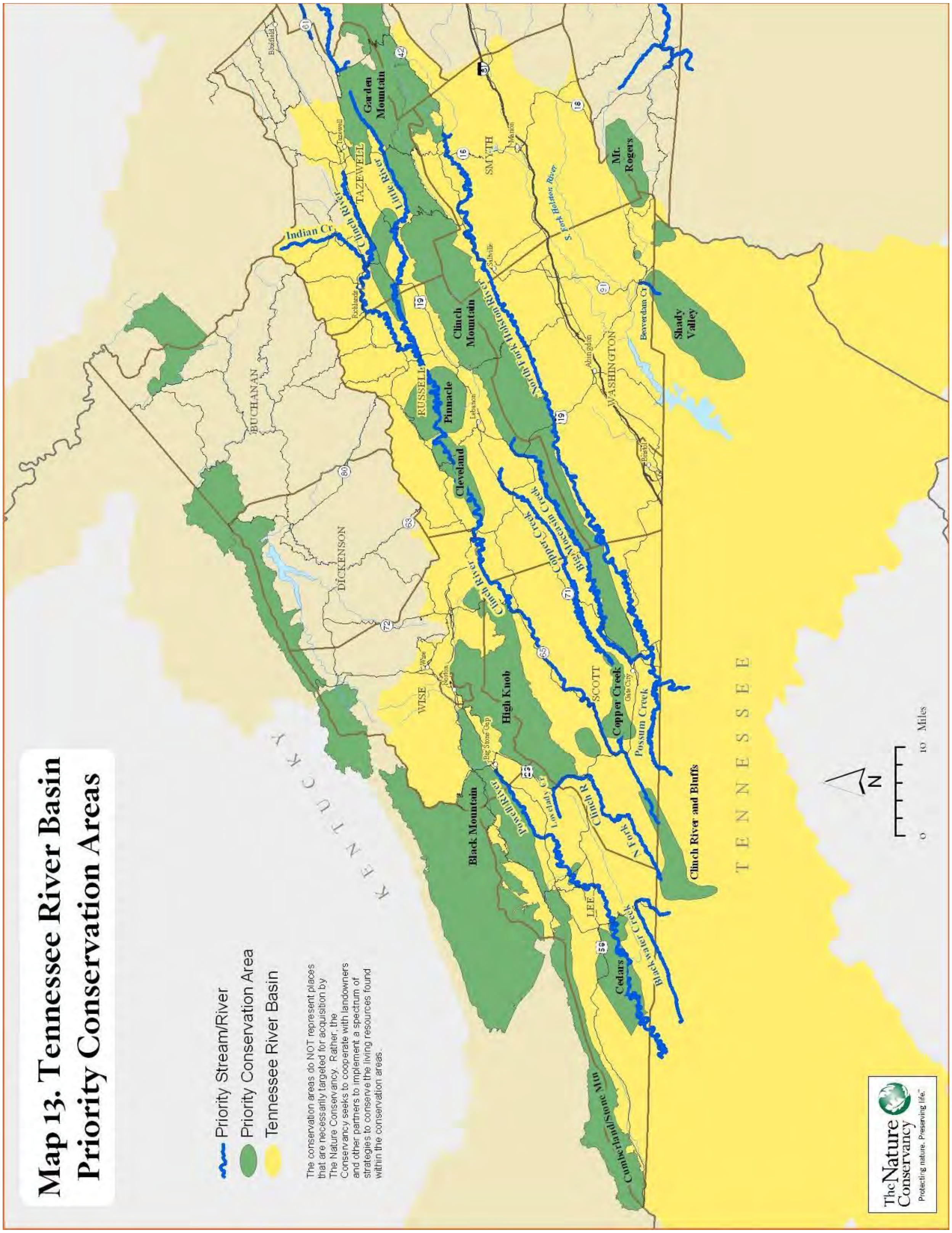
The counties of the upper Tennessee drainage make up just seven percent of the total area of Virginia, but contain half of known caves, with an average of 77 new caves described annually (VSS 2007). Currently, over 2000 caves have been documented in the CVP, and over 280 miles of cave passages have been surveyed (VSS 2007). The greatest development of karst biodiversity in the CVP area is in the Clinch and Powell watersheds (Holsinger and Culver, 1988). Particularly high levels of biodiversity and endemism occur in the Lee County karst region that extends from Tazewell, Tennessee to near Jonesville, Virginia. The majority of caves in these areas support globally-rare invertebrates that are known to occur in only one or two cave systems. Five significant karst areas have been prioritized for conservation: Thompson Valley/ Wards Cove, Rye Cove, Lee County/Cedars, Copper Creek, and a small area near our Miller's Yard preserve.

The karst topography of the CVP also supports several rare species of bats, including the Indiana bat (*Myotis sodalis*), the gray bat (*Myotis grisescens*), and the Virginia big eared bat (*Corynorhinus townsendii virginianus*), all three of which are Federally Endangered. The bats provide a nutrient input (guano) for the invertebrates and help connect caves to terrestrial and aquatic environments as they use these caves as hibernacula and bordering forests for foraging and dispersal.

D. THREATS

- Incompatible grazing practices
- Incompatible forestry practices
- Incomptible active mining practices
- Legacy mining practices

- Invasive, non-native pests and pathogens
- Invasive, non-native plant species
- Incompatible development
- Accidental toxic spills
- Incompatible oil and gas extraction
- Incompatible crop production practices
- Inadequate waste water treatment/management
- Energy transmission corridors
- Acid deposition
- Global climate change (air temperature extremes)
- Fire suppression
- Recreational activities



Map 13. Tennessee River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Tennessee River Basin
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
KENTUCKY
TENNESSEE
BUCHANAN
DICKENSON
WISE
LEE
SCOTT
RUSSELL
TAZEWELL
SMYTH
WASHINGTON
Garden Mountain
Clinch Mountain
Pinnacle
Cleveland
High Knob
Black Mountain
Copper Creek
Cedars
Cumberland/Stone Mtn
Clinch River and Bluffs
Mt. Rogers
Shady Valley
Indian Cr.
Clinch River
Little River
Powell River
Possum Creek
Blackwater Creek
N Fork
Beaverdam Cr.
S. Fork Holston River
0 10 Miles
N
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SERVICE AREA 14. BIG SANDY RIVER

A. DESCRIPTION

The Big Sandy Subbasin contains the Levisa and Tug Forks that flows northward into Kentucky forming the Big Sandy River which eventually empties into the Gulf of Mexico via the Ohio and Mississippi Rivers. The Big Sandy portion of the basin lies within the Cumberland Plateau. This province is characterized as rugged, with mountainous terrain and steep valleys. The Virginia portion of the Big Sandy is approximately 86 percent forest, with only about 5 percent in cropland and pasture. Urban areas make up only a small percentage of the total land area. All or parts of the following jurisdictions lie within the basin: Buchanan, Dickinson, Tazewell and Wise.

B. PRIORITY CONSERVATION AREAS (SEE MAP 14)

Name	Type	Acres
Breaks	Terrestrial Forest Matrix Block	14732.0
Needs Matrix Site Name #1	Terrestrial Forest Matrix Block	23513.3
Panther State Fore	Terrestrial Forest Matrix Block	8888.6
Ran Polly Gap	Terrestrial Forest Matrix Block	11319.3

C. CONSERVATION TARGETS

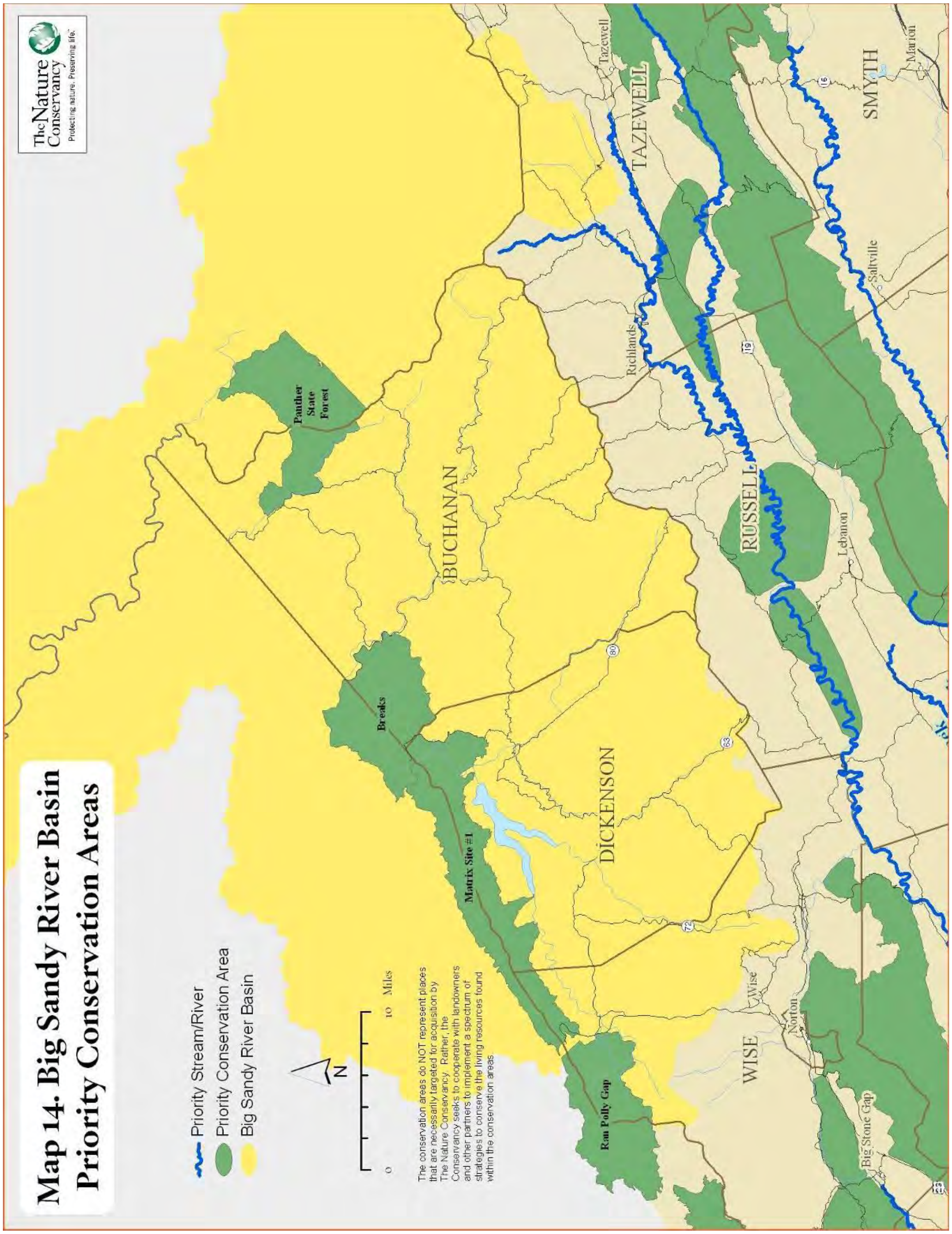
Southern Appalachian Forest Matrix

The temperate broadleaf forests of the southern Appalachians are among the most threatened terrestrial major habitat types, and many imperiled species and communities depend upon the larger forest matrix for survival. The Southern Appalachian Forest Matrix is the core terrestrial habitat of the northern portion of the Cumberlands Southern Ridge and Valley ecoregion. These forests provide habitat for most of the terrestrial species of plants and animals that currently or historically occur in the region. The southern Appalachian forest is composed of a range of different natural community types and successional stages. Deciduous trees are the dominant members of the community, with some hemlock in cove areas and pines on dry ridges. Spruce forests occur in special habitats on the highest ridges. The current forest is more homogeneous than desired due to past logging practices, lack of fire, and uncontrolled reversion from agricultural to forestland. The matrix target includes appropriate proportions of the full range of ecological alliances and associations that occur or should occur in the program area.

Other conservation targets to be determined through future planning efforts

D. THREATS

To be determined through future planning efforts


Map 14. Big Sandy River Basin
Priority Conservation Areas
Priority Stream/River
Priority Conservation Area
Big Sandy River Basin
N
0
10 Miles
The conservation areas do NOT represent places that are necessarily targeted for acquisition by The Nature Conservancy. Rather, the Conservancy seeks to cooperate with landowners and other partners to implement a spectrum of strategies to conserve the living resources found within the conservation areas.
Panther State Forest
BUCHANAN
Breaks
Matrix Site #1
DICKENSON
Ram Polly Gap
WISE
Wise
Norton
Big Stone Gap
RUSSELL
Lebanon
Richlands
TAZEWELL
Tazewell
SMYTH
Saltville
Marion

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