



This document contains one section of the EPA technical document, “Identifying and Protecting Healthy Watersheds,” published in February 2012. You can find the entire document at: <http://water.epa.gov/healthywatersheds>

Identifying and Protecting Healthy Watersheds

Chapter 5. Management Approaches

February 2012

5. Management Approaches



1

Introduction

This chapter introduces the Healthy Watersheds Initiative, discusses the characteristics of a healthy watershed, and reviews the benefits of protecting healthy watersheds. This chapter also describes the purpose, target audience, and intended use of this document.



2

Overview of Key Concepts

This chapter describes the healthy watersheds conceptual framework. It then discusses, in detail, each of the six assessment components – landscape condition, habitat, hydrology, geomorphology, water quality, and biological condition. A sound understanding of these concepts is necessary for the appropriate application of the methods described in later chapters. This chapter concludes with a discussion of watershed resilience.



3

Examples of Assessment Approaches

This chapter summarizes a range of assessment approaches currently being used to assess the health of watersheds. This is not meant to be an exhaustive list of all possible approaches, nor is this a critical review of the approaches included. These are provided solely as examples of different assessment methods that can be used as part of a healthy watersheds integrated assessment. Discussions of how the assessments were applied are provided for some approaches. Table 3-1 lists all of the assessment approaches included in this chapter.



4

Healthy Watersheds Integrated Assessments

This chapter presents two examples for conducting screening level healthy watersheds integrated assessments. The first example relies on the results of a national assessment. The second example demonstrates a methodology using state-specific data for Vermont. This chapter also includes examples of state efforts to move towards integrated assessments.



5

Management Approaches

This chapter includes examples of state healthy watersheds programs and summarizes a variety of management approaches for protecting healthy watersheds at different geographic scales. The chapter also includes a brief discussion of restoration strategies, with focus on targeting restoration towards degraded systems that have high ecological capacity for recovery. The results of healthy watersheds integrated assessments can be used to guide decisions on protection strategies and inform priorities for restoration.

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5.1 Implementing Healthy Watersheds Programs in States

A number of states are making protection of healthy watersheds, especially using a systems approach, an important part of their state programs. The restoration of impaired water bodies has long been a focus of many state water quality programs. This is due to the fact that 40-50% of the nation's assessed waters are listed as impaired (U.S. Environmental Protection Agency, 2008a). However, successful restoration and protection efforts work hand in hand. As important as restoration of impaired water bodies is, success in restoring ecological integrity will largely depend on pollution prevention and the protection of healthy aquatic ecosystems that provide the ecological infrastructure that supports restoration. The goal of the Healthy Watersheds Initiative is to help interested states and other partners identify and protect this critical natural infrastructure and inform restoration priorities, and increase awareness of how these states and other partners are using these approaches and techniques to improve aquatic ecosystems.

Interested states are now using Healthy Watershed Programs that complement the traditional focus on single problem management by utilizing a systems-based approach to meet the cross-disciplinary, cross-agency demands and challenges of aquatic ecosystem protection. This integrated approach to protecting aquatic ecosystems can help to achieve environmental results quickly and cost-effectively. This technical document and the complementary Healthy Watersheds Initiative website (www.epa.gov/healthywatersheds) are two resources that EPA has developed to help states accomplish this.

The following are examples of the efforts that three states (Minnesota, Virginia, and California) are taking to develop and implement state-specific Healthy Watersheds Programs.

Minnesota Healthy Watersheds Program

“What happens on our lands impacts our waters; what happens to our waters impacts our habitats, ecosystems, and biodiversity.”

Recognizing the need to connect management of the state's land and water resources, the Minnesota Department of Natural Resources (DNR) made a significant change to their organizational structure, which transformed their programs, operations, and research in order to increase focus on, and enhance support for, healthy watersheds throughout the state. Specifically, Minnesota DNR created a new Division of Ecological and Water Resources by integrating its former Division of Ecological Resources and Division of Waters. Integration of the two divisions into one will foster and accelerate the development of integrated approaches for improving the health of Minnesota's land and water at local, watershed, and landscape scales. Minnesota DNR recognizes that an integrated approach to resource management is necessary to effectively address multiple resource issues at multiple scales. This new division will better position Minnesota DNR to address the multiple pressures facing the state's land, water, fish and wildlife, and ecological resources, by leveraging existing systems of analysis and frameworks in complementary, rather than competing ways.

The new Division of Ecological and Water Resources is not just a merger of the work by the former Division of Ecological Resources and Division of Waters. Minnesota DNR's intention from the onset was to use this new division to facilitate “systems-oriented natural resources management” throughout the entire department. To initiate this department-wide transformation toward systems management, the new division is focusing its attention on their most threatened natural resources: water, biodiversity, and ecosystem services. By focusing their work around the central vision of “Healthy Watersheds,” DNR believes it can deliver even stronger protections for biodiversity and water resources (both ground and surface) than they were previously structured to provide. With this new division, Minnesota DNR will be able to better shape their management goals and strategies around protection and maintenance of vital ecosystem services—the natural processes that provide benefits to humans, such as water purification, biodiversity maintenance, flood mitigation, and soil fertility.

More information: http://files.dnr.state.mn.us/aboutdnr/reports/legislative/2010_healthy_watersheds.pdf

Virginia Healthy Waters Program

“At a time when so much of the news about the environment is negative, some biologists have been wading through Virginia’s streams in search of some positive information. What they’ve found suggests that there is another very important story.”

Virginia’s Healthy Waters Initiative was designed to raise awareness about the need to maintain ecological balance and protect the state’s critical healthy waters before they become impaired. Healthy Waters broadens existing conservation efforts to include the nearly 200 ecologically healthy streams, creeks, and rivers identified throughout the state thus far, as well as the many more expected to be identified in the future (streams throughout the state will continue to be assessed and added to the list as resources become available).

Healthy waters in Virginia are generally defined as those having the following characteristics: high number of native species and a broad diversity of species; few or no non-native species; few generalist species that are tolerant of degraded water quality; high number of native predators; migratory species whose presence indicates that river or stream systems are not blocked by dams or other impediments; low incidence of disease or parasites; and intact buffers of vegetation in the riparian zone. The current list of about 200 healthy waters in Virginia were identified and ranked (as “exceptionally healthy,” “healthy,” or “restoration candidate”) based on these and other characteristics, using a stream ecological integrity assessment method known as the Interactive Stream Assessment Resource, or InSTAR (see Section 3.6).

The Healthy Waters Initiative expands the existing water quality programs’ focus on restoring degraded water quality to protecting everything from aquatic insect larvae and bugs hidden in gravelly stream bottoms, to fish and amphibians, to forested buffers alongside streams, to natural stream flow, to the water that people drink. The identification and protection of healthy waters is expected to reduce the number of waters that will become degraded in the future.

More information: www.dcr.virginia.gov/healthywaters

California Healthy Streams Partnership

Led by the California State Water Board’s Surface Water Ambient Monitoring Program, the Healthy Streams Partnership seeks to promote improved ecological conditions of California’s streams by encouraging a paradigm shift from concern about impaired streams to an understanding of healthy stream systems and their ecological characteristics. By expanding this understanding, the Healthy Streams Partnership hopes to contribute to a change in perspective and thinking about natural resource management. With a strong focus on connecting science and policy, the Healthy Streams Partnership supports hypothesis driven data collection, analysis, and reporting to provide more useful and more integrated information to decision makers.

The Healthy Streams Partnership consists of representatives from the State and Regional Water Boards, the Department of Fish and Game, the State and Federal Contractors Water Agency, and the Coast Keeper Alliance. Coordination among these water quality data generating organizations is expected to increase the rigor of the state’s assessment capacity and to provide more contextual information to managers and decision-makers who may have an impact on stream conditions. They are currently working to gather various data sources into a “web portal” and online application for developing indices that translate various data types into a report card format that provides an assessment of overall stream condition. The effort focuses on including and synchronizing as many monitoring efforts as possible, striving for compatibility and comparability, and emphasizing the need for monitoring to be hypothesis driven, in support of statewide adaptive management effectiveness.

More information: http://www.swrcb.ca.gov/mywaterquality/monitoring_council/meetings/2011jun/hsp_outreach.pdf

5.2 Protection Programs

The following are examples of some of the many programs and strategies available for protecting healthy watersheds. The strategies and programs are identified as national, regional, state, or local scale approaches. These categories should not be considered rigid or constraining. They merely serve to organize the diversity of techniques that can be used to maintain and improve watershed health at different geographic scales.

5.2.1 National

Freshwater Conservation Priorities

Creating a set of freshwater conservation priorities helps to develop a common vision for galvanizing partners and stakeholders to implement a wide range of strategies in many places, allowing those with specific capacities, expertise, geographic, and programmatic responsibilities to contribute to that vision of success. The Nature Conservancy works with others to develop and implement approaches and tools to identify regional and basin-wide freshwater conservation priorities (Higgins J. V., 2003; Higgins, Bryer, Khoury, & Fitzhugh, 2005; Higgins & Esselman, 2006). These and similar approaches and tools have been applied across parts of five continents (Nel et al., 2009), including the vast majority of the United States (Higgins & Duigan, 2009). Examples from the United States include Smith et al. (2003), Weitzell et al. (2003), and Khoury et al. (2010) (see <http://www.conservationgateway.org/content/ecoregional-reports> for access to all currently available reports and data).

The Nature Conservancy has generally used a six-step conservation planning process to identify priorities for conserving the full range of freshwater habitats, processes, and biodiversity in a given region or basin. The first step is to define the assessment region. The region is defined using units that delineate environmental patterns and processes that result in freshwater ecological patterns. The region may be a collection of catchments within an ongoing terrestrial-focused assessment, a freshwater ecoregion, or a basin of a large freshwater system. Abell et al. (2008) provide a global coverage of freshwater ecoregions for conservation planning that is useful for defining assessment regions, or subregions within very large assessment regions.

The second step is to define and spatially represent the variety of biodiversity elements or ecosystems, which characterize environmental patterns, processes, and habitats that support the broad range of biodiversity in the region of interest. A subset of species and natural communities that require focused attention to ensure that rare, endangered, declining, keystone, and migratory species are appropriately represented in the plan are also identified in this step. Ecosystems are defined and mapped using a freshwater ecosystem classification approach (Appendix A).

Goals are set for defining the numerical redundancy and environmental stratification of elements thought to be necessary to maintain ecological and evolutionary potential across the region of interest. Most regions that are evaluated are large and contain subregions that differ in broad patterns of environmental characteristics (e.g., climate, geology, drainage density, presence of lakes) and species composition. Therefore, subregions are often delineated, and goals are set for each subregion using additional criteria such as conservation status and range of elements. Often, different sets of goals are created, generating different risk scenarios for sustaining biodiversity, where higher numerical goals represent lower risks to extirpation.

All of the occurrences of the biodiversity elements are then evaluated for their relative condition/integrity. Condition is assessed using best available information, commonly using abundance, density, or spatial extent of freshwater species, and the condition of the ecosystems, including: the intactness of species composition, ecological processes, physical processes, habitat ratings, and landscape context (includes but not limited to: degree of connectivity of habitats, locations and densities of dams, stream crossings, catchment and local contributing area, patterns of current and future land use/cover, and protected and managed areas).

Through working with partners and stakeholders to review and refine analytical products, priority catchments and connectivity corridors are selected to represent the areas of biodiversity significance (the best examples of each type of biodiversity element in each stratification unit) to best achieve goals in a comprehensive, yet efficient solution. Connectivity is especially important in aquatic systems, where connectivity of habitats is vital to maintain many ecological processes, species, and ecosystem services. The Active River Area approach described in Chapter 4 explicitly identifies areas important for processes and sources of water and material inputs for freshwater ecosystems. These areas include headwaters, riparian corridors, and floodplain wetlands. The Active River Area approach has been applied to many areas in the northeastern and southeastern United States (Contact The Nature Conservancy's Freshwater program for more information: <http://www.nature.org/ourinitiatives/habitats/riverslakes/index.htm>). Additional criteria considered in assessments include existing conservation opportunities, potential return on investments, ecosystem services, and climate change adaptation.

The last step of the conservation planning process defines the major threats that occur regionally and in each of those areas of significance, and develops strategies to address them. This process can be conducted on a regional scale and/or at the scale of each area. Regional strategy development is becoming more common, and defining strategies to address large scale threats and opportunities to leverage successful interventions requires a regional perspective. The selection of a subset of high priority areas based on risks of conditional change, opportunities to implement strategies, or leverage efforts to broaden their impact is recommended. Strategies can include managing dams for environmental flows and other water resource management activities, best management practices (BMPs), purchasing and/or reconnecting floodplain habitats to rivers, protection and rehabilitation of natural land cover, etc. Using this framework, The Nature Conservancy and its partners have developed regional freshwater conservation plans that cover the majority of the United States. Many GIS tools are available to use to define a suite of priorities. Priorities exist for the majority of the United States, and these provide a good place to start (<http://www.conservationgateway.org/topic/setting-freshwater-priorities>).



Case Study



Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin

More Information: Weitzell, Khoury, Gagnon, Schreurs, Grossman, & Higgins, 2003 (<http://www.natureserve.org/library/uppermsriverbasin.pdf>)

The Upper Mississippi River Basin (UMRB) is home to approximately 25% of the freshwater fish species in the United States and 20% of the mussel species found in the United States and Canada. NatureServe ranks 69 of these species as at-risk. Using the freshwater ecosystem classification approach described in Appendix A, the UMRB was divided into 22 subregions (Ecological Drainage Units). There were 153 species and 36 ecological systems defined and mapped as conservation elements. Goals were set for each species based on its proportional range representation and spatial distribution. The minimum goal for aquatic ecological systems was to conserve at least one of each unique system type in each ecological drainage unit it occurred in.

Relative condition/ecological integrity of the ecosystems was evaluated using land cover/use, impervious cover, road density, stream crossing density, dams, point sources, mines, and impaired stream designations. Local scientists and resource managers were consulted to provide additional information for use in the assessment and to review and adapt the examples that were chosen to best represent each biodiversity element.

The network of Areas of Biodiversity Significance was then constructed (Figure 5-1). Priority for inclusion was given to those ecological systems that captured species elements, had the highest relative ecological integrity, and were expert recommended

and/or included in already existing conservation plans. Inclusion of additional ecological systems and connectivity to support environmental processes was conducted by including all headwater ecological systems upstream of areas of biodiversity significance in the network. The medium rivers immediately downstream of each selected small river system were also included in the network. Finally, ecological system types that had not yet been included were added to ensure representation of all types. Goals were met for all ecological system types. The areas that were selected included representation of 102 of the species elements. Goals were met or exceeded for 45% of these species elements, including for 71% of the fish species and 55% of the mussel species. A subset of 47 areas that overlapped with terrestrial priorities were mapped to identify areas where conservation resources may be used more efficiently and outcomes may be more effective through cooperative and synergistic freshwater and terrestrial conservation actions.

A variety of strategies are being implemented across the UMRB by a range of partners and stakeholders. These strategies include demonstrations of floodplain protection and restoration, flow/water level management, alternative land use management and agricultural BMPs, restoring natural wetlands and creating artificial wetlands for processing land-based sources of nutrients, and retiling agricultural lands to manage soil moisture and nutrient applications, among others.

Continued on page 5-8

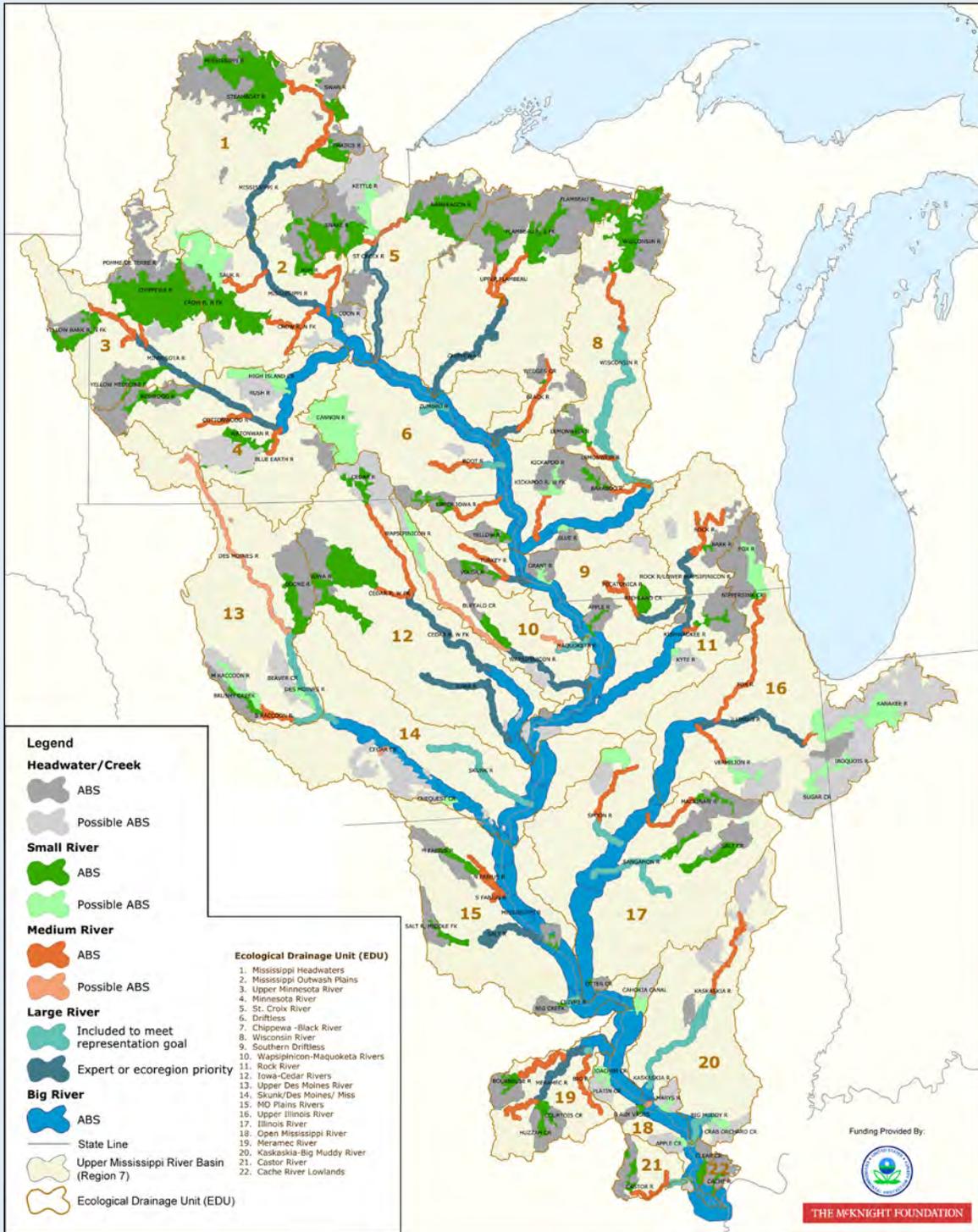
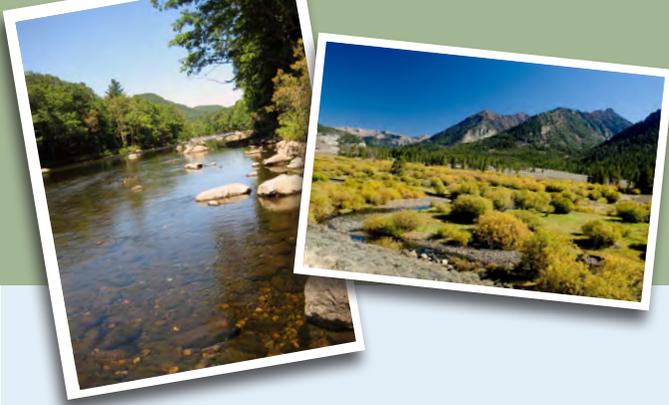


Figure 5-1 Areas of Freshwater Biodiversity Significance in the Upper Mississippi River Basin (Weitzell et al., 2003).

Wild and Scenic Rivers

Enacted in 1968, the Wild and Scenic Rivers Act protects free-flowing rivers from new hydropower projects, federal water resource development projects, and other federally assisted water resource projects (Interagency Wild and Scenic Rivers Council, 2009). Among other factors, to qualify for designation, a river must be free-flowing and have one or more “outstandingly remarkable” values. Outstandingly remarkable values are defined loosely, but typically include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values (Interagency Wild and Scenic Rivers Council, 2009). Rivers have traditionally been designated as a wild, scenic, or recreational river area through congressional designation. However, Section 2(a)(ii) of the Wild and Scenic Rivers Act authorizes the Secretary of the Interior to include a river already protected by a state river protection program in the National System upon the request of that state’s governor. Many states already have their own river protection programs in place. Inclusion in the National Wild and Scenic Rivers System ensures that (American Rivers, 2009b):

- A river’s “outstandingly remarkable” values and free-flowing character are protected.
- Existing uses of the river are protected.
- Federally licensed dams and any other federally assisted water resource projects are prohibited if they would negatively impact the river’s outstanding values.
- A quarter mile protected corridor on both sides of the river is established.
- A cooperative river management plan that addresses resource protection, development of lands and facilities, user capacities, etc. is developed.

Outside of federal lands, the federal government has little or no control over certain river resource threats, such as land use. Thus, it is critical that state and local organizations have a clear and effective plan for managing the protected river area. Floodplain zoning and wetlands protection laws are examples of state and local management actions that can be used to protect designated river areas.

Wildlife Action Plans

Two programs created by Congress in 2000, the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program, require the development of Wildlife Action Plans for all 50 states. These plans are meant to protect states’ wildlife before it becomes endangered or threatened. The plans evaluate wildlife habitat at the landscape level and target conservation actions at the local level. Many of these plans include aquatic resource protection. The plans are being implemented in all 50 states and receive funding from the U.S. Fish and Wildlife Service. Information from these plans can be used in the development of strategies to protect healthy watersheds. Partnerships with the many organizations involved in the development and implementation of wildlife action plans can be formed to the mutual benefit of both programs. Wildlife action plans can be used by local land use agencies and sewer and water utilities in facility siting determinations (to prevent habitat loss), land maintenance (to prevent the spread of invasive species), and other infrastructure decisions, including water withdrawal and discharge decisions (to prevent pollution) (Environmental Law Institute, 2007b). Some strategies that utilities have pursued include acquiring land to protect water recharge areas, putting land into conservation easements, initiating stream clean-ups, carrying out environmental education, and conducting biological research (Environmental Law Institute, 2007b).

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) can contribute significantly toward protecting healthy watersheds. The program is intended primarily to protect human life and property through requiring participating communities to adopt certain standards in their floodplain development ordinances. By participating in the program and complying with the standards, the communities receive insurance and assistance for flood-related disasters. The minimum requirements of the NFIP serve the purpose of protecting human life and property. However, through the Community Rating System, communities can implement floodplain management policies that exceed the NFIP minimum requirements and receive a significant discount in their flood insurance premiums. Many strategies using the No Adverse Impact approach promoted by the Association of State Floodplain Managers qualify for credit under the Community Rating System. Adverse impacts can be defined as increases in flood stages, velocity, or flows, the potential for erosion and sedimentation, degradation of water quality, or increased cost of public services (Vermont Law School Land Use Institute, 2009). The No Adverse Impact approach extends development management beyond the floodplain to include managing development in any area within the watershed that may have an adverse impact on downstream property owners. For example, it promotes limiting the amount of impervious surfaces allowed on new development sites or requiring mitigation strategies such as infiltration basins to capture the increased runoff from new impervious surfaces. Another example is the Vermont Stream Geomorphic Assessments discussed in Chapter 3, through which a fluvial erosion hazard (FEH) zone is defined. Using this approach, the state has begun assisting communities in developing and implementing FEH districts, which have qualified under the Community Rating System program for providing additional protections not provided for in the NFIP minimum requirements, which do not address fluvial erosion.

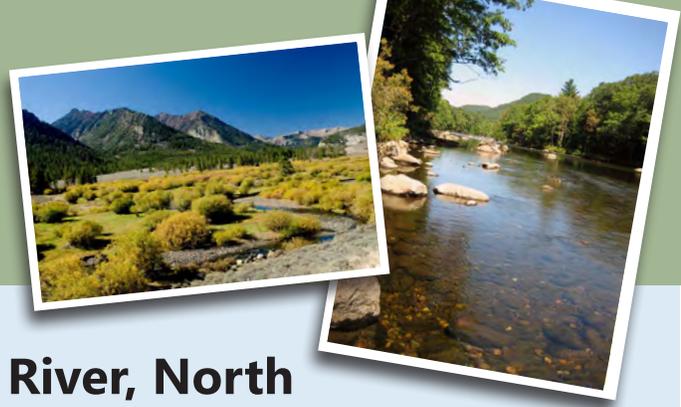
The U.S. Forest Service's Forest Legacy Program

The U.S. Forest Service's Forest Legacy Program purchases conservation easements to protect tracts of forest lands greater than 100 acres that are vulnerable to development and growth pressures. Thirty seven state forest legacy programs have identified water quality, wetland, and riparian buffer protection as goals of their program. The program is administered in cooperation with state partners. For example, the Forest Service worked with the State of Montana and a number of other partners to protect nearly 8,000 acres in the North Swan River Valley, the most intact biological ecosystem remaining in the lower 48 states. Forest Legacy Program funding was leveraged with other funding to complete the protection of 66,000 acres in Swan Valley. Landowners must prepare a multiple resource management plan with project costs of which at least 25% must be funded by private, state, or local sources. Landowners benefit from the sale of the property rights and also from reduced taxes on the preserved open space once the sale is complete.

The Trust for Public Land's Center for Land and Water

The Trust for Public Land's Center for Land and Water works in partnership with communities across the nation to identify and protect the most critical watershed lands for maintaining healthy aquatic resources. The Center protects these lands by designing networks of conservation lands, facilitating conservation transactions, and supporting funding and legislation for land protection. Much of the Center's efforts are focused on protecting lands surrounding drinking water sources. By assisting with land acquisition or conservation easements in the watersheds of source waters, the Center helps to minimize nonpoint sources of pollution that can threaten water supplies. The Enabling Source Water Protection in Maine and Lower Meramec Drinking Water Source Protection Project case studies at the end of this section describe specific examples of the Center's work.

Case Study



Wild and Scenic Rivers: Lumber River, North Carolina

More Information: <http://www.rivers.gov/wsr-lumber.html>

The Lumber River is located in south-central North Carolina, and although most of the river corridor is in private ownership, it is virtually unmodified. In 1996, North Carolina's governor petitioned the Secretary of the Interior to add 115 miles of the river to the National Wild and Scenic Rivers System. The river had previously received protection under the North Carolina Natural and Scenic Rivers Act, and a State Park Master Plan had recently been developed for the river corridor. This plan outlined a strategy for the state to work with local governments on future land use and zoning regulations and acquire riparian lands through fee simple purchase and conservation easements.

As part of the national designation process, an examination of existing zoning was conducted to determine if the river would receive adequate local protection while the master plan strategy was being implemented. The City of Lumberton amended its land use ordinance by adding the Lumber River Protection Overlay District to ensure that the river received designation as a National Wild and Scenic River, a source of pride for the community. The river was successfully designated as a result of local river protection interests, key political leaders, scientists, and the National Park Service working together throughout the process.



The Lumber River, North Carolina (The Lumber River Conservancy, 2009).

5.2.2 State and Interstate

Antidegradation

In addition to defining designated uses and identifying water quality criteria, states and authorized tribes are required to develop and adopt statewide antidegradation policies that protect and maintain: existing instream uses and their associated water quality; high quality waters, unless the state or tribe finds that allowing lower water quality is necessary to accommodate important economic or social development; and outstanding national resource waters (ONRW), as designated by the state or tribe. They are also required to identify implementation methods for the antidegradation policy. These implementation methods typically define how the high quality waters will be identified, what activities will trigger the antidegradation review process, and the components of an antidegradation review. All waters of a state should be categorized into one of three protection Tiers. Tier 1 is the minimum baseline of protection afforded to all waters of a state and requires that existing uses and their associated water quality be maintained and protected. Tier 2, high quality waters, are those waters that exceed the minimum quality necessary to support the CWA's "fishable/swimmable" goals and can only have their water quality lowered when the state or tribe finds the lowering to be "necessary to accommodate important economic or social development," as determined through the antidegradation review process. No degradation is allowed in Tier 3 waters, ONRWs, except on a short-term, temporary basis, as identified by the state's or tribe's policies and procedures. Antidegradation applies when an activity lowers water quality and is, therefore, an attractive option for states or tribes to pursue in the protection of healthy watersheds. Healthy watersheds assessments can help strengthen and inform Tier 2 and Tier 3 designations.

Instream Flow Protection

With the ever increasing demands that humans place on freshwater resources for drinking water, power generation, and industrial and agricultural uses, aquatic biota are experiencing not only lower flows, but a loss of the natural variability in flows. Historical methods for determining instream flow needs focused on single species, often leading to decreased health of the larger ecosystem (Poff N., 2009). Scientists now understand that the natural flow regime must be maintained to ensure aquatic ecological integrity. This understanding is beginning to be integrated into flow management by the U.S. Army Corps of Engineers, who have been working with The Nature Conservancy on pilot projects like those on the Savannah River in Georgia (Richter, Warner, Meyer, & Lutz, 2006), and utilities like the Rivanna Water and Sewer Authority, also working with The Nature Conservancy on developing environmental flow management practices (Richter B., 2007). Both projects defined flow prescriptions for a river segment by evaluating ecological and social needs. More information on managing instream flows for humans and ecosystems can be found in Postel and Richter (2003).

Some states, such as Washington, Massachusetts, Connecticut, South Carolina, and Michigan have begun developing flow management and water allocation policies to ensure protection of instream flows. For example, Michigan uses its Water Withdrawal Assessment Tool, described in Chapter 3, to develop flow alteration-ecological response curves for various classes of rivers, and the effects of proposed surface water and ground water withdrawals can be estimated with an online user interface. Use of this tool is required for all new >100,000 gallons per day withdrawal applications as part of the implementation of a variety of Michigan water allocation policies intended to protect and restore instream flows. Similarly, Connecticut has developed draft stream flow regulations based on expert consensus and best available science to set flow standards for six seasonal bioperiods. The regulations apply to surface water withdrawals and reservoir releases. The Massachusetts Water Policy is a comprehensive approach to water management that seeks to maintain sufficient quantity and quality of water for aquatic life and human use. It leverages the benefits of Smart Growth to "keep water local" by: allowing for infiltration of precipitation onsite, instead of sending it across impervious surfaces and down storm drains; encouraging municipalities to live within their water budgets and not import water from other basins; and increasing treated wastewater recharge and reuse. These actions help to maintain natural river flow conditions. South Carolina passed the Surface Water Withdrawal and Reporting Act in 2010

that sets water-permitting requirements for withdrawals greater than 3 million gallons per month; establishes statewide, seasonally variable minimum flows to protect aquatic life, recreation, and water supply; and requires new users to have contingency plans so that they can cease their consumptive use of water when stream flows get too low.

The Columbia Basin Water Transactions Program uses a variety of mechanisms to ensure sufficient instream flows throughout the basin in Washington, Oregon, Montana, and Idaho. Some of the tools used include (National Fish and Wildlife Foundation; Bonneville Power Administration, 2004):

- Water Acquisitions:
 - Short and long-term leases.
 - Permanent purchase.
 - Split Season — A portion of a water right is used for irrigation in the spring and the remainder is left instream in late summer/fall.
 - Dry Year Option — An opportunity to lease a water right during a particularly dry year.
 - Forbearance agreement.
 - Diversion reduction agreement.
- Boosting Efficiency:
 - Switching from a flood to sprinkler irrigation system.
 - Modernizing headgates.
 - Improving ditch efficiency.
- Conserving Habitat:
 - Protecting/restoring stream habitat and changing a portion of the associated water right.
- Rethinking the Source:
 - Changing the point of diversion from a tributary to a main stem in order to improve stream flows.
 - Switching from surface to ground water source.
- Pools:
 - Rotational pool — A group of irrigators take turns leaving a portion of their water in stream.
- Banks:
 - Water Banking — Producers in an irrigation district “bank” water they may not need so it can be available for other uses.

Using Antidegradation to Protect Instream Flows

The Tennessee Division of Water Pollution Control regulates water withdrawals that can lower water quality or affect designated use support in waters of the state. Most regulated water withdrawals in the state are for public water supply. Tennessee's permit process under antidegradation requires an alternatives analysis, which includes social, economic, and environmental considerations. Regional water supply planning conducted by the community is an important tool to help identify water supply alternatives that avoid or minimize degradation. From the regulatory perspective, an environmental review should seek to avoid and minimize degradation. From the community's perspective, an environmental review should include the affected public and represent their interests. The alternatives analysis helps encourage avoidance and minimization, while the intergovernmental coordination and public participation provisions help ensure that the community has input on potentially important economic or social development.

The alternatives analysis process has led to the development of regional, coordinated water supply planning to address permit application requirements and the Division of Water Pollution Control has assisted in the completion of two such pilot efforts. In one case, the regional plan showed that the raising of an existing dam would serve as a regional supply for the stated planning horizon and was therefore justified under antidegradation; and that other water supply development proposals within the region were therefore not justified. In the other case, the impoundment and lowering of water quality of a tier two stream was shown to be unjustified; and that purchase of treated water from a nearby utility who obtained their raw water from the Cumberland River was feasible.

Other innovations in water supply planning are occurring throughout Tennessee. For example, the Huntsville utility district operates an existing withdrawal on a tier two stream, the New River, a tributary of the Big South Fork National Recreational River. The Huntsville utility district has recently applied for a permit to increase their withdrawal rate and volume from the New River. However, they propose to change their operation to harvest water based on the amount of flow in the river and subsequently withdraw no more than 5% of the flow at any time. This minimization of impact was driven, in part, by Tennessee's de-minimis flow reduction standard, serving as a presumptive flow standard.

Source Water Protection

The Safe Drinking Water Act (SDWA) Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the safety of public drinking water sources throughout the state. States have completed source water assessments for virtually every public water system in the nation, from major metropolitan areas to the smallest towns. A source water assessment is a water system-specific study and report that provides basic information about the source water used to provide drinking water. Many of the biggest threats to source waters identified in SWAPs are related to land use practices. These include stormwater and nonpoint source runoff (e.g., from fertilized crop lands), septic systems, and chemical storage tanks at commercial and industrial sites. Drawing from resources such as EPA's Drinking Water State Revolving Fund (DWSRF) and Clean Water State Revolving Fund (CWSRF), states can assist local water suppliers with source water protection measures, including a variety of land use management tools, to address the threats identified in the SWAP. These two EPA financing programs are administered by each of the states and may provide funding to projects that support compliance with SDWA drinking water standards (DWSRF) or protect, enhance, or restore water quality (CWSRF). The interest rates on loans under these programs are typically well below market rates and have flexible repayment terms that can be extended up to 20 years.

Land trusts have also taken advantage of both the DWSRF and CWSRF for land acquisition. Aligning State Land Use and Water Protection Programs is an EPA-funded initiative that will have strategies and lessons learned to share with other states. Initiative partners (The Trust for Public Land, Smart Growth Leadership Institute, River Network, and the Association of State Drinking Water Administrators) are working with a small group of states to identify opportunities to work across political and programmatic boundaries to better align planning, economic development, regulation, and conservation to protect drinking water sources at the local and watershed level (see www.landuseandwater.org).

Growth Management

Some states have growth management laws, which typically provide more specific guidance to localities in the development of land use plans than do the more typical land use planning enabling laws. In addition to providing specific guidance and requirements, growth management laws also sometimes include a state land use plan to guide local land use planning (Environmental Law Institute; Defenders of Wildlife, 2003). However, the primary authority to regulate land use remains with the local government. Some growth management laws establish mechanisms for adjoining jurisdictions to coordinate their planning activities (Environmental Law Institute; Defenders of Wildlife, 2003). The State of Washington is protecting “critical areas” through the use of its Growth Management Act (see case study at end of section).

State River and Habitat Protection Programs

Many state agencies maintain habitat protection programs and river protection programs that seek to protect riparian areas and river corridors. Some examples include: Vermont’s integrated river corridor protection program, which is used to protect riverine and riparian habitat, in addition to protecting human infrastructure from flood and fluvial erosion hazards; Michigan’s Natural Rivers Program that protects riverine and riparian habitats; Wyoming’s statewide planning process to protect wetland-associated habitats; Maryland’s GreenPrint Program; and Minnesota’s state legislation for fen protection.

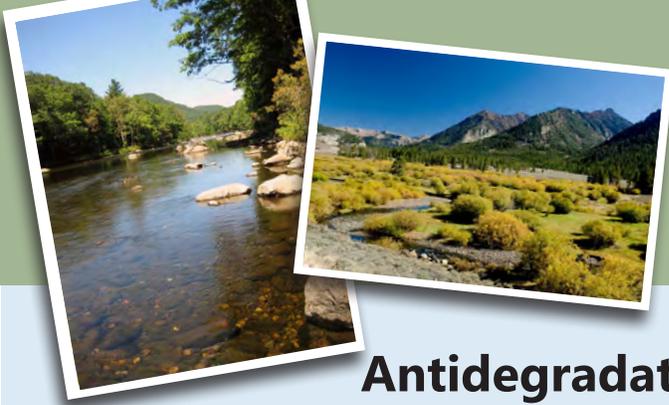
Both voluntary and regulatory techniques are frequently used to implement these programs, and collaboration with local governments and organizations is key to their success. For example, the New Hampshire River Management and Protection Program is administered by the New Hampshire Department of Environmental Services and a statewide River Management Advisory Committee. However, protection hinges upon partnerships between the state and local municipalities. Local individuals or organizations nominate rivers when sufficient local support is demonstrated. Once approved by the state, designated rivers receive protection from potential threats according to the classification they were given at the time of designation: natural, rural, rural community, or community. Protection measures consider channel alterations, dams, hydroelectric energy facilities, interbasin water transfers, protected instream flows, siting of solid and hazardous waste facilities, recreational river use, and water quality. A local advisory committee consisting of representatives from all riverfront municipalities develops and implements a management plan for the designated river with assistance from the Department of Environmental Services. Local advisory committees also comment on activities requiring state or federal permits that may impact the river. The intent of the River Management and Protection Program is to balance competing demands for river resources for the benefit of present and future generations.

The Massachusetts Rivers Protection Act takes a somewhat different approach to river protection. The Act protects the 200 feet of land adjacent to either bank of every perennial river, stream, or brook, with a few exceptions in densely populated urban areas, where only 25 feet on either side of the perennially flowing water body is protected. These tracts of land, referred to as riverfront areas, are protected from any new development unless the developer can prove to the local conservation commission or the Massachusetts Department of Environmental Protection that there is no practicable alternative for the development or that the development will not have a significant adverse impact on the river. As a result, the Rivers Protection Act protects a seamless network of the state’s perennially flowing water bodies.

Minnesota Fen Protection

<http://www.dnr.state.mn.us/eco/wetlands/index.html>

Calcareous fens are a wetland type characterized by a non-acidic peat substrate and dependent on a constant supply of cold, oxygen-rich ground water with high concentrations of calcium and magnesium bicarbonates. Calcareous fens are some of the rarest natural communities in the United States and are highly susceptible to disturbance. The Minnesota Wetlands Conservation Act protects calcareous seepage fens from being “filled, drained, or otherwise degraded, wholly or partially, by any activity, unless the commissioner of natural resources, under an approved management plan, decides some alteration is necessary” (Minnesota Department of Natural Resources, 2008). In addition, any state-threatened plants occurring on a calcareous fen are protected under Minnesota’s endangered species law.



Case Study

Antidegradation: Delaware River Basin Commission Special Protection Waters

More Information: <http://www.state.nj.us/drbc/spw.htm>

The Delaware River Basin Commission adopted Special Protection Waters regulations in 1992, 1994, and 2005 to protect existing high quality waters in areas of the Delaware River Basin deemed “to have exceptionally high scenic, recreational, ecological and/or water supply values.”

The Special Protection Waters regulations adopted in 1992 and 1994 initially applied to a 121-mile stretch of the Delaware River from Hancock, NY downstream to the Delaware Water Gap, and its drainage area. This corridor includes the two sections of the river federally designated as “Wild and Scenic” in 1978, as well as an eight-mile reach between Milrift and Milford, PA which is not federally designated.

In 2000, federal legislation was enacted adding key segments of the Lower Delaware and selected tributaries to the National Wild and Scenic Rivers System. This designation was followed in April 2001 with a petition from the Delaware Riverkeeper Network to the Delaware River Basin Commission to classify the Lower Delaware as a Special Protection Water. Extensive water quality data were collected from 2000 through 2004 at over 26 tributary and main-stem Delaware River locations. The resulting water quality data confirmed that existing water quality in this stretch of river exceeded most state and federal standards, making it a worthy candidate for the Delaware River Basin Commission’s anti-degradation program.

Based in part upon these findings, in 2008 the Delaware River Basin Commission permanently designated the 76-mile stretch of the non-tidal lower Delaware River between the Delaware Water Gap and the head of tide at Trenton, NJ as Special Protection Waters (Figure 5-2). The entire 197-mile non-tidal Delaware River is now protected by Special Protection Waters anti-degradation regulations.

The primary focus for the Special Protection Waters Program is to ensure that the existing high quality waters are not measurably changed as a result of point source discharges and to mitigate the impacts of nonpoint source pollution from new service areas. In order to evaluate point source discharge projects for conformance with the Special Protection Waters Program, Commission staff prioritized water quality model development in those watersheds that have a high number of existing point source discharges as well as in those watersheds that were expected to have new growth and associated wastewater discharge needs.

The water quality models are used to predict changes to water quality as all of the existing and proposed point source discharges reach their permitted flow/loads. These cumulative impact models are then utilized to identify effluent limitations for the point source discharges to prevent a measurable water quality change to Special Protection Waters.

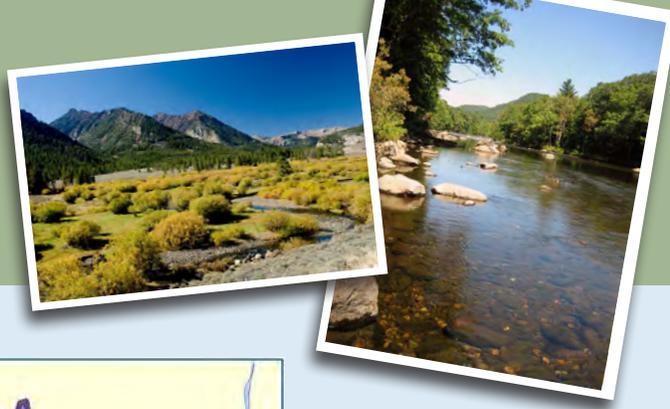


Figure 5-2 The Delaware River Basin Commission (DRBC) permanently designated the entire 197-mile non-tidal Delaware River as a Special Protection Water (SPW) subject to anti-degradation regulations (image courtesy of Robert Tudor, DRBC).



Case Study

Washington Critical Areas Growth Management Act

More Information: <http://www.commerce.wa.gov/site/418/default.aspx>

The State of Washington adopted its Growth Management Act (GMA) in 1990 in response to rapid, uncoordinated, and unplanned growth that was threatening the environment, sustainable economic development, and the health, safety, and high quality of life afforded to its citizens. The Act requires all Washington counties and cities to designate and protect critical areas and natural resource areas. Critical areas include wetlands, fish and wildlife habitat conservation areas, aquifer recharge areas, frequently flooded areas, and geologically hazardous areas. Natural resource areas include forest, agricultural, and mineral lands. The Act has 14 goals that include reducing sprawl by focusing growth in urban areas, maintenance of natural resource based industries and encouragement of sustainable economic development, and protection of the environment by retaining open space and habitat areas. Based on county population and growth rate, some counties (and all cities within them) are required to fully plan under the GMA, while others can choose to plan. However, all cities and counties are required to designate and protect critical areas.

Although each city and county is required to designate and protect critical areas, functions, and values under the GMA, they are given wide latitude in how they do so. The State of Washington provides guidance and technical assistance, including example codes and ordinances, but continues the tradition of allowing local government to control its own land use decisions by allowing them to choose the particular strategies and tools they will use. However, designation and protection of critical areas must include the “best available science” and must give special consideration to protection of anadromous fish habitat. A variety of

regulatory and non-regulatory tools are available to communities for protection of critical areas, including zoning, subdivision codes, clearing and grading ordinances, critical areas regulations, conservation easements, public education, and transfer of development rights. The focus is on performance measures designed to protect the functions and values of each critical area. Although critical areas can be protected with a number of regulations, many communities in Washington include a separate critical areas chapter in their development regulations. The State Environmental Policy Act, Shoreline Master Program, Storm Water Management, and Clearing and Grading Ordinances are also useful for protecting critical areas, and any critical areas regulations should be consistent with these programs.

In 2008, Snohomish County conducted an effectiveness monitoring study to determine how well it was protecting the functions and values of critical areas. The county uses regulatory (critical areas regulations), non-regulatory (best management practices), and monitoring and adaptive management to protect its critical areas. The critical areas regulations have science-based standards for techniques such as buffer widths around wetlands and streams. Alternative and innovative approaches are permitted when they can be shown to achieve the same level of protection as the regulations. A combination of permit tracking, enhancement project tracking, remote sensing, shoreline inventories, and intensive catchment studies are being used to determine the impacts of development on critical areas, with a focus on fish and wildlife habitat (Haas, Ahn, Rustay, & Dittbrenner, 2009).

Case Study



Michigan Water Withdrawal Assessment Process

More Information: <http://web2.msue.msu.edu/bulletins/Bulletin/PDF/WQ60.pdf>

In response to the Great Lakes – St. Lawrence River Basin Water Resources Compact of 2005, the Michigan State Legislature enacted new laws to manage large-quantity water withdrawals based on hydroecological principles. Public Act 179 of 2008 defines a large-quantity water withdrawal as an average of 100,000 gpd over any consecutive 30 day period. Using a process that parallels the Ecological Limits of Hydrologic Alteration, Michigan has classified river segments, determined flow-ecology relationships, and identified environmental flow targets based on socially acceptable ecological conditions. To implement its policy, Michigan has created a statewide water withdrawal assessment tool (Chapter 3).

The water withdrawal assessment tool uses “fish response curves” to evaluate the impact of a water withdrawal on fish populations in the 11 different stream types defined for Michigan (Figure 5-3). The stream types are defined based on habitat characteristics such as catchment size, base flow yield, and July mean water temperature. The fish response curves were developed using fish abundance and stream flow data to determine relationships between flow reduction and change in fish populations for all 11 stream types. Using the water withdrawal assessment tool, the user inputs the proposed location and quantity of their withdrawal, and the tool estimates the level of impact. Depending on the

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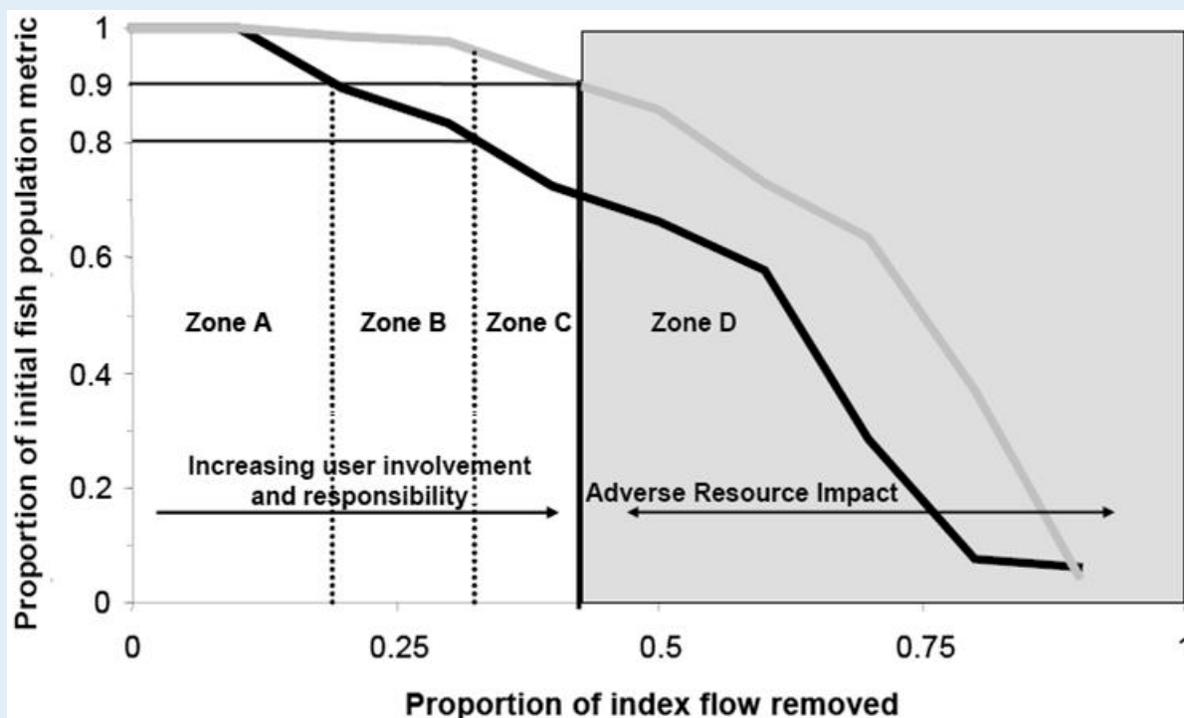
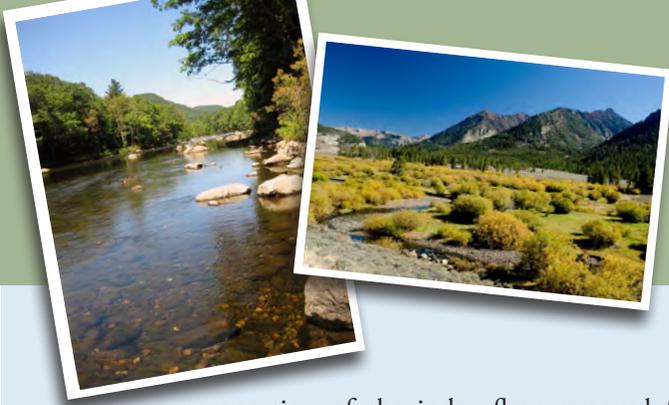


Figure 5-3 Example fish response curves. The dark curve represents “thriving species still thriving” at incremental reductions in index flow. The light curve represents “characteristic species still present and abundant.” (Troy Zorn, MI DNR, Personal Communication).



proportion of the index flow removed for a given stream type, the proportion of the fish population remaining can be determined through the use of the fish response curves. Four zones of index flow reduction have been defined for each stream type. These zones represent different policy actions as shown in Figure 5-4.

analyses can be conducted to determine the appropriate zone and consequent action. A new Water Resources Conservation Advisory Council was created to evaluate and oversee the state's water management programs, including the Water Withdrawal Assessment Process. The council ensures that the process is inclusive and collaborative and that it is based on the best available science.

The water withdrawal assessment tool is considered a screening tool. When appropriate, site-specific

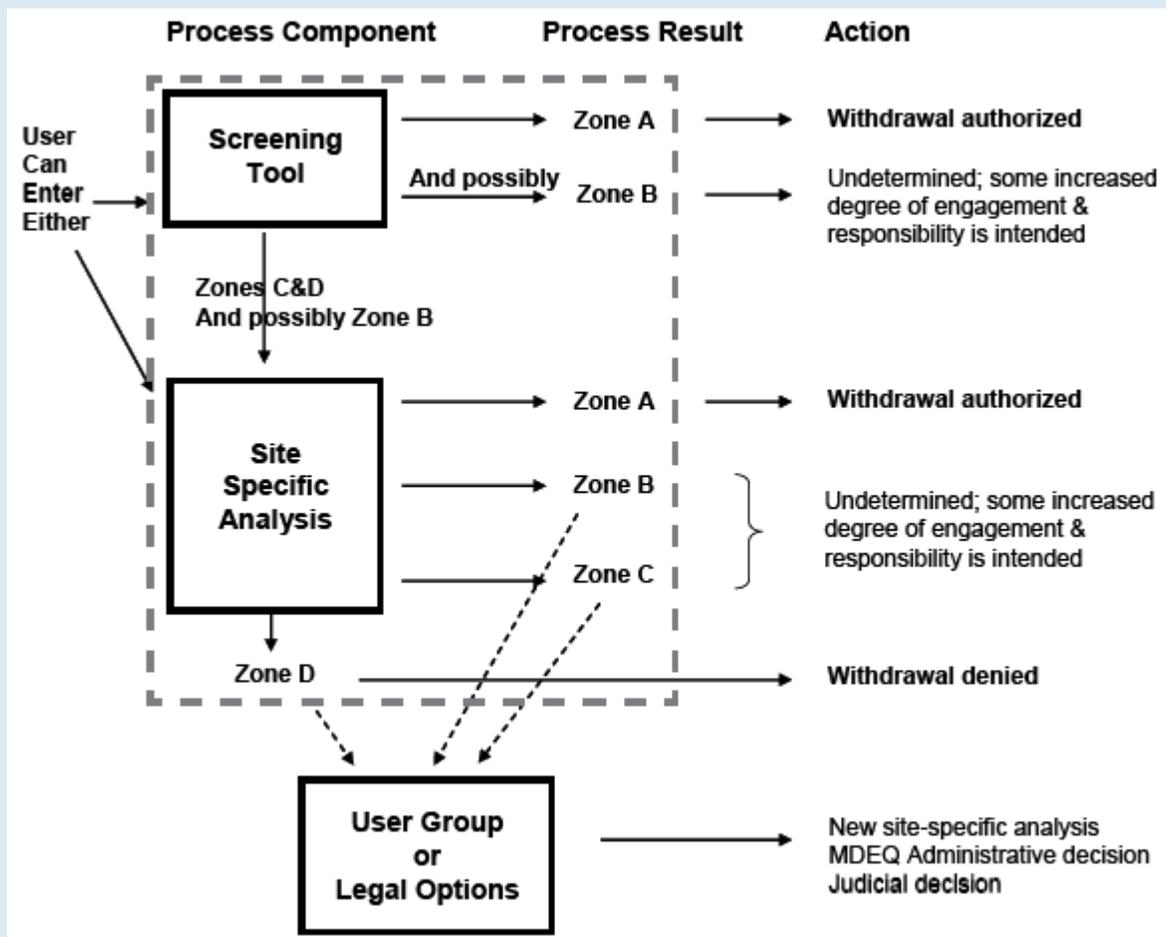


Figure 5-4 Illustration of the water withdrawal assessment process and resulting actions. (Troy Zorn, MI DNR, Personal Communication).

Case Study



Vermont River Corridor Protection Program

More Information: Kline, 2010 (http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_restoration.htm)

The Vermont River Corridor Protection Program is a program of the Department of Environmental Conservation, within the Agency of Natural Resources (ANR), that seeks to restore and protect the natural values of rivers and minimize flood damage. Achieving natural stream stability over time through a reduction in riparian infrastructure can minimize cost from flood damage and improve aquatic and riparian ecological integrity. Vermont ANR provides technical assistance to communities throughout the state to help delineate river corridors, develop municipal fluvial erosion hazard zoning districts, and implement river corridor easements. Delineation of the river corridor is carried out using the stream geomorphic assessment protocols described in Chapter 3. The primary purpose of this delineation, with respect to river corridor planning, is to capture the meander belt and other active areas of the river that are likely to be inundated or erode under flooding flows. As part of the stream geomorphic assessment, a stream sensitivity rating is assigned to each reach based on existing stream type and geomorphic condition.

Based on the river corridor delineations, Vermont ANR works with communities to develop river corridor plans that analyze geomorphic condition, identify stressors and constraints to stream equilibrium, and prioritize management strategies such as:

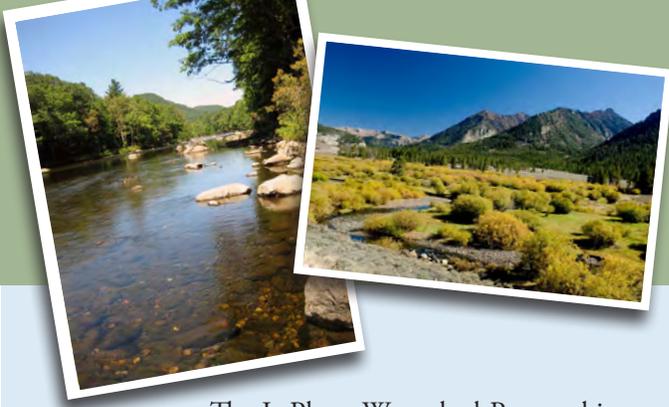
- Protecting river corridors.
- Planting stream buffers.
- Stabilizing stream banks.
- Arresting head cuts and nick points.
- Removing berms and other constraints to flood and sediment load attenuation.
- Removing/replacing/retrofitting structures (e.g., undersized culverts, constrictions, low dams).
- Restoring incised reaches.
- Restoring aggraded reaches.

By focusing on “key attenuation assets,” flood and fluvial erosion hazards, water quality, and habitat are improved at minimum cost. Attenuation areas are captured in the corridor delineation process and include Active River Area components such as floodplains, wetlands, and riparian vegetation that store flood flows and sediments and reduce watershed nutrient and organic matter inputs.

The river corridor plans are incorporated into existing watershed plans, and ANR also works with municipalities to develop Fluvial Erosion Hazard Area Districts in their bylaws or zoning ordinances. A River Corridor Easement Program has also been established to purchase river channel management rights (Figure 5-5). This prevents land owners from dredging and armoring the channel and gives the easement holder the right to establish vegetated buffers in the river corridor.

The Town of Hinesburg, Vermont developed a stream corridor plan for the LaPlatte River in 2007 to take advantage of the stream geomorphic assessments that had already been completed and to develop river corridor protection projects. The plan development process began with outreach and education activities including landowner contact through direct mailing of informative letters followed up by telephone calls to each landowner. Meetings were scheduled with each landowner to discuss the planning process and reach condition details specific to each landowner’s parcel. Presentations were also given to the Select Board, Conservation Commission, and Planning Commission at the beginning and end of the planning process.

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The LaPlatte Watershed Partnership used the stream geomorphic assessment results and conducted a stressor, departure, and sensitivity analysis to prioritize planning and management strategies for each reach. They identified strategies such as properly sizing stream crossings (i.e., bridges and culverts) when these structures are up for replacements or repairs, implementation of a Water Resources Overlay District (which encompasses the FEH

zone), planting of stream buffers, and restoration of incised reaches. The Town of Hinesburg adopted stream buffers and setback requirements in its zoning regulations that prevent encroachment into the stream corridor, protecting property and the ecological integrity of the LaPlatte River.

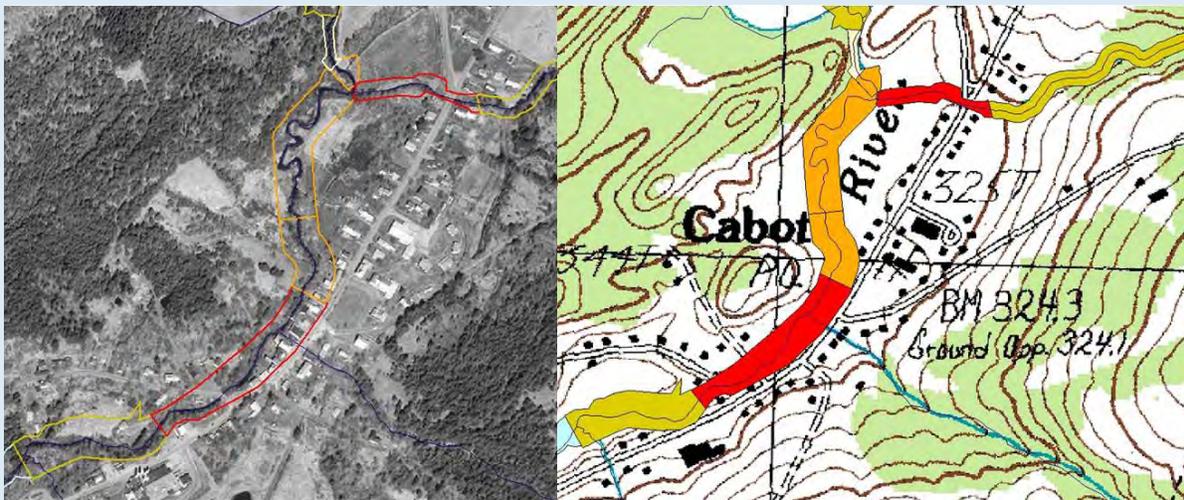


Figure 5-5 Map and orthophoto depicting the meander belt width-based river corridor being considered for protection in the Town of Cabot, Vermont to help restore water quality, aquatic habitat, and natural channel stability of the Winooski River. The belt width corridor is designed to accommodate the geomorphology and fluvial processes associated with the river's dynamic equilibrium condition (Mike Kline, Vermont Agency of Natural Resources, Personal Communication).

Case Study



Michigan's Natural Rivers Program

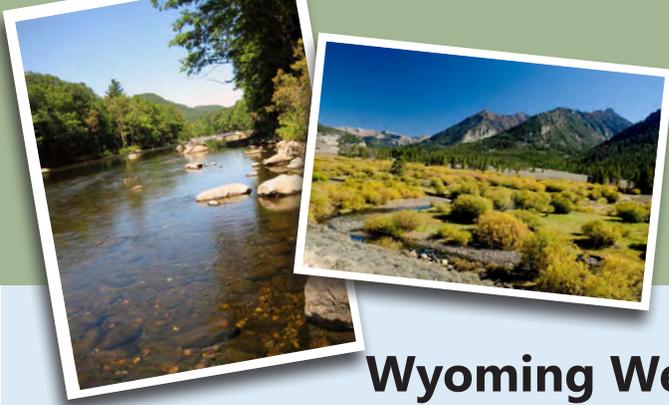
More Information: http://www.michigan.gov/dnr/0,1607,7-153-30301_31431_31442---,00.html

The State of Michigan's Natural Rivers Act, passed in 1970, established The Natural Rivers Program as part of the Habitat Management Unit in the Fisheries Division of the state's Department of Natural Resources (DNR). Since the program's establishment, 2,091 miles on 16 rivers have been designated as part of Michigan's Natural Rivers System. The system serves to preserve and enhance a variety of values each river provides for current and future generations, including: aesthetics, free-flowing condition, recreation, boating, historic value, water conservation, floodplain, ecological, fisheries and other aquatic life, and wildlife habitat. In this way, the Program focuses on protecting natural river ecosystem conditions so that rivers can continue to provide ecosystem services to their local communities for many years to come.

In order to be considered for designation in the program, stakeholders must form an advisory group to develop a comprehensive management plan for a river. Management plans include baseline data describing the river's condition, defined river segments proposed for designation, and proposed standards for land development in the river's Natural River District, defined as the land area extending 400 feet from either side of the river's edge. Standards typically include structural and septic system setbacks (100-200 feet from the water's edge), natural riparian buffers (25-100 feet from the water's edge), minimum lot size and frontage requirements (one acre with 100-200 feet of frontage), and prohibitions on filling or building in the 100-year floodplain or wetlands. The standards also restrict use of the Natural River District to residential development and limit timber harvest, oil and gas activity, bank stabilization activities, intensive habitat management of fisheries and public lands, and public access. Because the Natural River

District applies to both public and private lands, a river's designation into Michigan's Natural Rivers System incorporates uniform standards across all land ownerships and multiple jurisdictions, resulting in a seamlessly protected green infrastructure corridor along the river's banks.

Once a river has been designated as part of the Natural Rivers System, a permit process is used to oversee development in the Natural River District. Property owners wishing to conduct activities in Natural River Districts apply for Natural River zoning permits from the Program administrators for their districts. Program staff conduct site inspections with applicants and issue permits once it has been determined that the applicant's activity complies with development standards. The Zoning Review Board, a seven-member board consisting of representatives from each affected County and Township, NRCS, local citizens, and the DNR may grant variances in cases where standards cannot be met. Local governments may become Natural Rivers Program administrators on private lands in their jurisdictions by adopting Natural River zoning standards into a county or town ordinance. Natural Rivers Program staff support local government program administrators by reviewing ordinance language amendments, commenting on variance requests, and monitoring to ensure uniform Program administration within each river system. In addition to local governments, watershed councils, Resource Conservation and Development programs, the U.S. Forest Service, Trout Unlimited chapters, canoe livery owners, and the Michigan Department of Environmental Quality have also collaborated with the DNR to contribute to the success of Michigan's Natural Rivers Program.



Case Study

Wyoming Wetlands Conservation Strategy

More Information: <http://gf.state.wy.us/habitat/WetlandConservation/Wyoming%20Wetlands%20Conservation%20Strategy%20September%207,%202010.pdf>

The Wyoming Joint Ventures Steering Committee has developed a statewide wetlands conservation strategy to meet seven goals: 1) delineate important wetland and riparian habitat areas and assess their condition, 2) identify threats to the functional integrity of wetlands and riparian habitats, 3) set state and regional conservation goals and priorities, 4) develop conservation and management strategies for wetlands and riparian habitats, 5) promote partnerships among existing conservation initiatives, 6) connect with non-conservation-based funding and planning resources, and 7) build technical support for the wetland component of the Wyoming State Wildlife Action Plan. The Committee identified nine wetland complexes to be prioritized for conservation in the next 10-year planning horizon. Six of these complexes were selected for meeting two criteria: 1) a Shannon diversity rank no greater than five, and 2) “high” project opportunity. The other three complexes were selected due to their ecological uniqueness and/or a high level of public interest. Data from a 1995 Statewide Comprehensive Outdoor Recreation Plan and an assessment conducted by The Nature Conservancy in 2010 support these selections.

The first step in implementing this conservation strategy is to build the state’s capacity to support wetlands conservation projects. A pooled state agency and non-governmental organization approach, a state wetlands coordinator position, and/or new funding sources may be developed to provide needed technical resources that have been historically lacking to write grant proposals and plan, permit, and oversee projects. Local and regional wetlands and riparian habitat conservation priorities will be identified in “step-down” plans for the following four areas: protection, restoration, creation and enhancement, and recreation. Priority conservation projects for each of the four areas will be identified and made publicly known through a Wyoming Wetlands Web site. In addition, the “step-down” plans will be used to set statewide objectives and priorities for the same four

areas. Protection priorities will focus on acquisitions and conservation easements.

The state’s highest conservation priority at this time is to ensure “no net loss” of existing wetlands and riparian habitats. This requires enforcing existing protections, effective mitigation of unavoidable losses, strategic use of federal financial incentives, and negotiating land and water use rights to protect high-risk areas. The committee is considering a variety of approaches to foster land and water use that is protective of wetlands in the private sphere. These approaches include: management and stewardship agreements, property leases (including water rights), managing the timing of when water rights are exercised, temporary water transfers, rehabilitation and improvement of irrigation systems, the development of ground water wells to supply constructed wetlands, and potentially reintroducing beaver populations. The establishment of minimum stream flows that mimic natural hydrographs, removal of barriers to stream connectivity, and discouraging floodplain development are other tactics that may become a part of Wyoming’s wetlands conservation strategy. Lastly, the Committee also proposes that an effort be made to incorporate wildlife habitat creation, enhancement, maintenance or management into the state’s legal definition of beneficial uses of water to expand the set of water sources that can potentially be used to support wetlands.

Wyoming’s wetlands conservation strategy incorporates several prioritization techniques that can be similarly applied to prioritize healthy watersheds for protection. Wetlands identified as conservation priorities are likely to be found in healthy watersheds that would be identified as protection priorities. In these and other ways, wetlands conservation and healthy watersheds protection strategies can be developed synergistically to preserve the integrity of healthy watersheds.

Case Study



Maryland's GreenPrint Program

More Information: www.greenprint.maryland.gov

The State of Maryland has identified fragmentation and development of its natural and working lands as its biggest future conservation challenge. To address this challenge, Maryland's Program Open Space developed a tool known as GreenPrint (Figure 5-6) to identify the state's most ecologically valuable areas and track their conservation. The tool uses GIS data layers to identify overlap between areas that are priorities for the following four conservation foci: green infrastructure, water quality protection, rare

species habitat, and aquatic biodiversity hotspots (Figure 5-7). Areas that are conservation priorities for several of these purposes are then designated as targeted ecological areas (TEA). It is likely that there will be overlap between areas that should be protected as healthy watersheds and TEAs because both are landscape-level approaches to protecting the integrity of freshwater systems.

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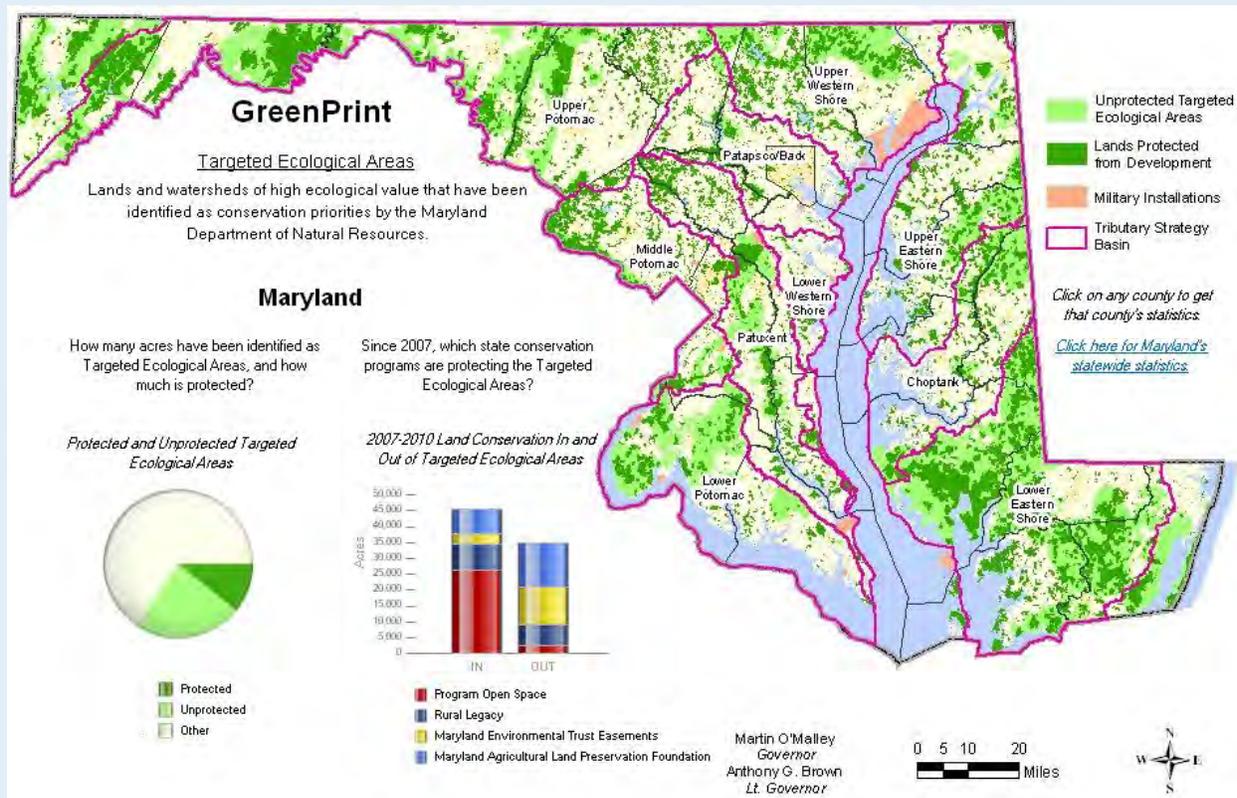


Figure 5-6 Maryland's GreenPrint map of targeted ecological areas (Maryland Department of Natural Resources, 2011).

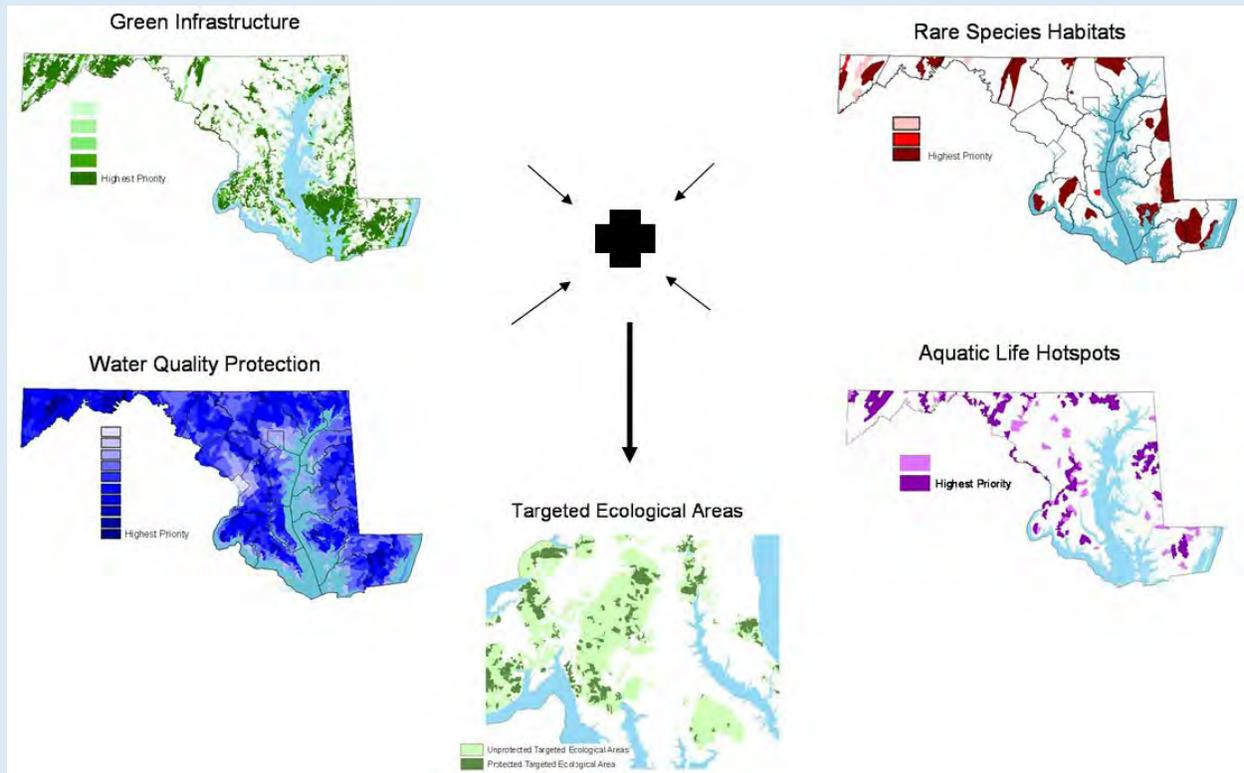


Figure 5-7 Identification of targeted ecological areas (Maryland Department of Natural Resources, 2011).

Maryland’s Board of Public Works uses an ecological ranking protocol to measure how conservation projects contribute to the protection of TEAs. The protocol requires that each conservation project be evaluated using a standard scorecard. The scorecard asks project managers to address the four aforementioned conservation priority areas used by GreenPrint in both a landscape score and a parcel ecological characteristic score. Other components that contribute to the project’s final score include recreational or cultural value, restoration value, consistency with local land use, and provisions for future management of

the land. The Board of Public Works also uses the scorecards to track how many projects are located in GreenPrint TEAs as a key performance measure for Program Open Space. The goal of the GreenPrint Program is to channel conservation resources into protecting TEAs, thus supporting both the green and blue infrastructure needed to maintain a complete ecological network across the state.

Case Study



Enabling Source Water Protection in Maine

More Information: <http://www.landuseandwater.org/index.htm>

Maine's landscape is home to an abundance of lakes, ponds, and rivers. Many of these surface waters, and associated ground waters, serve as sources of drinking water for local residents. Unlike most states, utilities in Maine are often able to provide only minimal treatment to their source waters before distribution to customers. This is due to the high quality of these source waters in their natural condition. Although Maine has already taken a number of measures to ensure that its aquifers and surface sources continue to provide clean drinking water into the future, the state decided to participate in the Enabling Source Water Protection initiative, an EPA-funded project to integrate state land and water programs. The project is a partnership among the Trust for Public Land, the Smart Growth Leadership Institute, the River Network, and the Association of State Drinking Water Administrators. The Enabling Source Water Protection project assesses state programs to recommend the best opportunities for program alignment that will support local communities in their source protection efforts.

Working with a diverse group of state agency representatives, public water systems, non-profit organizations, and other interested stakeholders, the national project team identified key opportunities for improved collaboration in the areas of smart growth, conservation, and water quality. After soliciting stakeholder input and feedback on the identified opportunities, the project team identified successful implementation efforts from other states and created a draft action plan for Maine. Using an online survey, stakeholders were asked to read the document to further refine and prioritize action items. Those steps rated as low impact, high investment and low chance of success were eliminated from consideration.

Developing a dedicated statewide funding source for drinking water source protection was identified as the action that would have the highest positive impact, but that would require long-term planning and implementation. The final action plan focuses on those action steps where the majority of respondents rated them as: having high impact on drinking water source protection; requiring low-to-moderate investment of public resources; demanding high urgency for implementation; having a short-to-medium time frame for implementation; having a moderate-to-high chance for implementation; and requiring low-to-moderate (primarily administrative) effort to implement.

In-depth analysis of existing programs and listening sessions with representatives from across the state revealed that three key short-term actions can assist with better synergy between land use and drinking water source protection: 1) Employing the State of Maine's Quality of Place Investment Strategy to strengthen drinking water source protection, using the state's ability to direct funding for infrastructure and economic development. 2) Continuing a phased investment in on-line mapping resources and information sharing to provide critical data to local governments and developers so they can make more informed land-use decisions. 3) Developing guidelines for compatible recreational opportunities in and around sensitive protection areas to provide greater access to conservation funding and a broader constituency to preserve lands and waters important for drinking water. Maine's Drinking Water Program has initiated implementation efforts in all of these areas.

5.2.3 Local

Land Protection

Land trusts are typically non-profit entities that coordinate the acquisition of land, or easements that limit development on land, for the purpose of protecting open space and conserving natural resources. Land can be donated, sold at a discount, or sold at market price to local, state, or federal government, or to land trusts that will typically then serve as the stewards of that land or entrust stewardship to a local or state government agency. A conservation easement is a tool that allows the landowner to maintain ownership of the land while entering into a legal arrangement to limit the uses of the land. For example, a farmer may own a large tract of land that can be sold on the private market and be developed, or they can work with a land trust to place an easement on the property whereby the land is permitted to remain in agricultural use or to remain idle but is not permitted to be developed. Organizations such as The Trust for Public Land, American Farmland Trust, and The Land Trust Alliance can provide information and assistance on land protection issues. Conservation easements and other types of development restrictions can be pursued by state and local governments as well. Many states provide income or other tax credits to landowners who donate land or easements for conservation purposes. This can be a useful mechanism for increasing voluntary participation in conservation.

Green infrastructure assessments, such as those described in Chapter 3, are increasingly being used as an overarching conservation framework in the comprehensive planning process of municipalities and counties. Some maintain their approach within the strict definition of green infrastructure, while others have expanded their programs to consider “working lands” such as agricultural areas, historic lands, and cultural resources. Identification of a community’s green infrastructure is the first step in preserving it. The community’s zoning and comprehensive plan (or master plan) can then be revised to plan for growth around the green infrastructure (see sidebar). Chapter 3 contains additional examples of green infrastructure assessments and the role that they play in local land use planning.

The Protected Areas Database of the United States partnership is creating a national inventory of all public and private protected lands. The draft data layer is available for download and online viewing and can be used to identify lands already in conservation easements or some other kind of protection status (Protected Areas Database of the United States Partnership, 2009). This resource can be helpful in further prioritizing adjacent lands for protection or restoration.

Land Protection and Climate Change

Land protection and stewardship are critical components of protecting healthy watersheds. They are especially important in a changing climate. EPA recently evaluated the decision-making strategies of land protection programs across the country in the context of climate change impacts. Programs that focus on wildlife and watersheds were chosen for the evaluation due to the impacts that climate change is expected to have on these elements. The authors used the Trust for Public Land’s LandVote database (2009), which compiles information

The Central Texas Greenprint for Growth: A Regional Action Plan for Conservation and Economic Opportunity, Texas

<http://envisioncentraltexas.org/resources/GreenprintMkt.pdf>

The City of Austin, Texas launched its smart growth program in 1998 after years of advocacy surrounding watershed protection and parks. The most sensitive third of the region’s land drains into the Edwards Aquifer in Texas. This area was designated as a “Drinking Water Protection Zone” by the city’s residents, and the remaining two thirds were designated a “Desired Development Zone.” Since then, Travis County and surrounding counties that are part of the Austin metropolitan area have been growing quickly. The Greenprint that the Trust for Public Land, the Capitol Area Council of Governments, and Envision Central Texas developed in partnership with Travis, Hays, Bastrop, and Caldwell County residents suggests directing development towards areas with existing infrastructure and away from the sensitive lands draining to the aquifers. The Greenprint’s opportunity maps identify lands that are most important for regional water quality and quantity protection for each of the counties. It includes maps for conservation lands to achieve other goals that residents identified as well. Travis County, Hays County, and City of Austin voters have repeatedly approved tax increases to purchase land and development rights in order to protect critical lands in the region.

on land protection activities across the nation, to analyze these management trends. The large majority of land protection programs evaluated did not consider climate change in their decision making process (U.S. Environmental Protection Agency, 2009b). However, the report identified strategies that might be useful for land protection programs on how to consider climate change in future transactions. These include decision support tools for advisory committees, promulgation of different land protection models (e.g., purchase, as opposed to transfer, of development rights), and educational outreach for elected officials (U.S. Environmental Protection Agency, 2009b). Land protection strategies should consider both the mitigation potential of the land through carbon sequestration and the adaptation potential of the land for protecting water resources and wildlife migration routes, as well as the potential to buffer infrastructure from storm events (U.S. Environmental Protection Agency, 2009b).

Carbon markets are an emerging approach for mitigation of climate change and conservation of forested lands, and may play an important role in land protection strategies in the coming years. Deforestation is responsible for 20% of all carbon emissions worldwide. Since forests sequester large amounts of carbon, protection of these lands is a critical element in addressing climate change. Carbon markets provide a mechanism whereby an emitter of carbon dioxide can purchase carbon credits from sellers to offset their own emissions below a “cap,” usually determined by a government or international body. The sellers must be emitting less than the cap to have any credits to sell. Credits can also be determined through the use of a baseline, as opposed to a government imposed cap. By helping to prevent deforestation, land protection can generate credits based on the amount of carbon emissions avoided.

As the effects of climate change increasingly manifest themselves, adaptation strategies will become more and more important. A certain amount of climate change will occur regardless of the actions taken to reduce future greenhouse gas emissions. Consequently, adaptation strategies are an important component to addressing climate change. An important component of these strategies can be to protect the remaining natural areas. Wetlands and headwater streams, for example, regulate the downstream flow of water, retaining water in wet conditions and releasing it in dry conditions. They thereby serve as important components for protection against both floods and droughts. Riparian vegetation protects streams from the effects of increased runoff expected in many parts of the country due to increased intensity and frequency of extreme storm events. Also, vegetated riparian areas provide habitat and corridors for migration.

Land Use Planning

From a big picture perspective, protecting healthy watersheds has a lot to do with land use, sprawl, and development. River banks are often armored to “protect” riparian development, but this practice typically exacerbates erosion downstream. Increased impervious surfaces associated with development often increase runoff volumes and the build-up and wash-off of pollutants into surface waters. Wildlife habitat and valuable plant communities are lost when natural land cover is removed to make way for new development. The natural disturbance regime is disrupted when the natural fire regime is suppressed, large withdrawals are made from rivers or ground water, or dams are constructed to generate electricity to satisfy the ever increasing demands of residential and industrial growth.

Green Infrastructure and Master Plans Alachua County, Florida (Alachua County, 2008)

Following the state’s leadership in green infrastructure, Alachua County, Florida updated their master plan in 2005 to include specific policies that require or incentivize protection of wetlands, surface waters, floodplains, listed species habitat, significant geologic features, and the highest category of protection, “strategic ecosystems.” Strategic ecosystems are specific mapped areas in Alachua County that are the 47 most significant natural communities, both upland and wetland, remaining in private ownership. Minimum conservation standards for this green infrastructure include protection of all wetlands and surface waters, protection of at least 50 percent of all upland within the strategic ecosystems, conservation easements, management plans, and environmentally friendly designs. Development rights are preserved through increased allowable densities on buildable areas or by transfer of development rights to other properties.

One of the greatest contributions to protecting healthy watersheds may come from ecologically-based land use planning. Land use regulation is primarily a local authority, with the state responsible for establishing the laws and regulations that enable local land use planning. These laws vary considerably from state to state, but generally provide guidance to localities (sometimes mandatory, sometimes voluntary) in the development of comprehensive plans (sometimes referred to as master plans). Some state land use planning laws require that natural resources are taken into account in comprehensive plans (Environmental Law Institute; Defenders of Wildlife, 2003). Others require provisions for protection of open space or require consideration of wildlife habitat (Environmental Law Institute; Defenders of Wildlife, 2003). Some states may not require these issues to be considered in the development of comprehensive plans, but may suggest it. Some state land use planning laws require the state to develop a statewide land use plan or policy (Environmental Law Institute; Defenders of Wildlife, 2003). Other states are authorized to provide support or assistance in the development or implementation of local land use plans (Environmental Law Institute; Defenders of Wildlife, 2003).

In an evaluation of the role of conservation in land use planning, the Environmental Law Institute (2007a) made six general recommendations for how to advance conservation planning:

1. Develop communications tools that convey the value of ecological knowledge and conservation planning to decision makers.
2. Develop requirements and incentives for proactive conservation planning.
3. Measure the effectiveness of conservation planning and implement adaptive management where needed.
4. Find ways to overcome the disconnect between the different scales at which land use planning and conservation are carried out.
5. Define specific conservation thresholds (e.g., minimum riparian buffer width) based on the best available science.
6. Provide a technical support infrastructure and interdisciplinary training for planners and conservation scientists.

Smart Growth is a land use planning concept that can contribute significantly towards protecting healthy watersheds. Smart Growth refers to a land use strategy to prevent sprawl and create communities with diverse transportation, employment, and housing options. It focuses on minimizing the development of natural and rural areas by directing growth within cities through rehabilitation and reuse of existing infrastructure, improving public transit and bicycling or walking options, and making urban environments more desirable places to live. The Smart Growth Network (2009) identifies 10 principles of smart growth:

1. Create a range of housing opportunities and choices.
2. Create walkable neighborhoods.
3. Encourage community and stakeholder collaboration.
4. Foster distinctive, attractive communities with a strong sense of place.
5. Make development decisions predictable, fair, and cost effective.
6. Mix land uses.
7. Preserve open space, farmland, natural beauty, and critical environmental areas.
8. Provide a variety of transportation choices.
9. Strengthen and direct development towards existing communities.
10. Take advantage of compact building design.

These principles have been adopted by numerous states in their own smart growth programs intended to assist communities in developing local strategies to prevent sprawl and minimize the loss of remaining natural areas. Transportation and land use are two closely related issues. Traditional zoning practices encourage separation of land uses, requiring motorized transport for people to travel to work, go grocery shopping, etc. Public transit

options have virtually disappeared in all but the largest cities, leaving people with no choice but to purchase automobiles, exacerbating the problem even further. By encouraging mixed land uses, increasing public transit and bicycling/walking options, and directing development towards existing communities, the pressures that create sprawl can be reduced, and more of our remaining natural places can be preserved.

Higher density development has recently been recognized as a strategy that can help prevent the spread of impervious surfaces, landscape fragmentation, and overall ecological degradation (U.S. Environmental Protection Agency, 2006b). Although high density development may have higher proportions of impervious surfaces per acre, it can actually reduce the total amount of impervious surfaces in the watershed. This is partly because high density development decreases need for roads and parking lots. High density development is compatible with the 10 principles of Smart Growth.

Watershed-Based Zoning in James City County, Virginia

<http://www.jccegov.com/environmental/index.html>

James City County, Virginia completed its Powhatan Creek Watershed Management Plan in 2001. Due to the rapid development experienced in the previous two decades, the county decided to pursue a watershed-based zoning approach to protect its high quality streams from future development impacts. An impervious cover and instream/riparian habitat assessment categorized each of the county's subwatersheds as Excellent, Good, Fair, or Poor. Using a combination of innovative land use planning techniques, including transfer of development rights, conservation development, rezoning, and resource protection overlay districts, the county has directed growth away from its most sensitive and ecologically valuable subwatershed and developed strategies to minimize further impacts in those degraded subwatersheds designated for growth. Each subwatershed was also targeted for other specific management measures to either conserve, protect, or restore streams according to the level of threat imposed on each.

Conservation Development (sometimes referred to as cluster design) is a zoning strategy that decreases residential lot sizes and clusters the developed areas together, protecting the remaining areas as shared open space. This prevents large lot development, which has contributed to suburban sprawl and habitat fragmentation. By clustering development together, whether in rural cluster designs, or by taking advantage of infill development of cities, sprawl, and excessive spread of impervious surfaces are reduced. Additional information on conservation development can be found in Arendt (1999).

Watershed-based zoning is a land use planning strategy based on the boundaries of small watersheds. By directing future development towards watersheds where it will have the least negative impact, this strategy can protect watersheds with high ecological integrity. This strategy involves significant collaboration between adjacent municipalities, as watershed boundaries rarely coincide with political boundaries. A watershed-based zoning approach should include the following nine steps (Schueler, 2000):

1. Conduct a comprehensive stream inventory.
2. Measure current levels of impervious cover.
3. Verify impervious cover/stream quality relationships.
4. Project future levels of impervious cover.
5. Classify subwatersheds based on stream management “templates” and current impervious cover.
6. Modify master plans/zoning to correspond to subwatershed impervious cover targets and other management strategies identified in Subwatershed Management Templates.
7. Incorporate management priorities from larger watershed management units such as river basins or larger watersheds.
8. Adopt specific watershed protection strategies for each subwatershed.
9. Conduct long-term monitoring over a prescribed cycle to assess watershed status.

Revision of zoning regulations and/or the use of transfer of development rights are usually necessary in implementing watershed based zoning. Transfer of development rights is a technique that allows a land owner in an area designated as a priority for protection by local government to sell their development rights to another land owner in an area designated for higher density development.

In addition to zoning strategies, counties and municipalities have the ability to create a variety of other ordinances that can serve to protect valuable natural resources. The Center for Watershed Protection (2008a) and EPA (2006a) both have web sites with model ordinances available for communities to use in developing their own local ordinances to protect natural resources and ecologically valuable areas. These include ordinances to protect aquatic buffers, open space, wetlands, etc.

Low Impact Development (LID) is a stormwater management approach that focuses on managing runoff at the source through the use of design practices that allow for infiltration, storage, and evaporation. Rain gardens, pervious pavements, tree box planters, green roofs, and disconnected downspouts are all examples of LID practices. These practices have been shown to be less expensive and more environmentally friendly than more traditional stormwater management practices, such as conveyance systems (U.S. Environmental Protection Agency, 2007b). LID practices help to reduce stormwater runoff from urban areas, which can improve water quality, ground water recharge, and the biological condition of stream habitats. However, the potential for ground water contamination must also be considered, especially in areas with contaminated soils.

River Corridor and Headwaters Protection

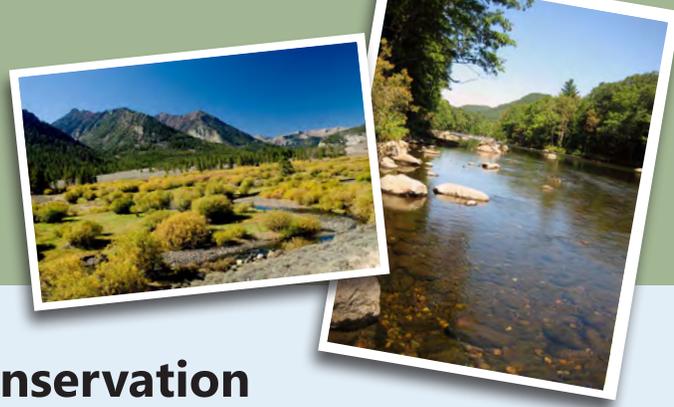
As discussed in Chapter 2, natural river corridors are important for maintaining dynamic equilibrium of the river channel, providing valuable wildlife habitat, and regulating floodwaters. When designing river corridor protection strategies, it is important to remember that river channels can migrate laterally over time. When possible, the entire river corridor should be protected from development through the use of fluvial erosion hazard area districts, river corridor easements, and other local programs (Kline & Dolan, 2009). The State of Vermont is in the process of implementing a statewide river corridor protection program. Using the results of their statewide stream geomorphic assessments (Chapter 3), state staff are working with local stakeholders to identify river corridor protection options such as easements and zoning overlay districts. These strategies are designed to protect the dynamic nature of the riparian area. Simple riparian buffer protection ordinances and overlay districts are certainly beneficial for water quality and wildlife, yet they often fail to address all of the requirements of the riverine system as it meanders over time and experiences flood events. River corridor protection benefits not only water quality and wildlife, but also public safety (Kline & Cahoon, 2010).



Amy Draut

As described in the River Continuum Concept (Vannote, Minshall, Cummins, Sedell, & Cushing, 1980), headwater streams contain unique assemblages of organisms that begin the processing of coarse particulate organic matter, providing the energy required by other assemblages of organisms downstream. Healthy headwater stream areas provide valuable wildlife habitat and corridors for migration of wildlife. They also provide sediment, nutrient, and flood control in much the same way that wetlands do. Headwater streams also help to maintain base flow in larger rivers downstream. Fundamental to a healthy watershed, properly functioning headwater streams are one of the primary determinants of downstream flow, water quality, and biological communities. Protection of these areas through land use planning and protection is particularly important.

Case Study



Headwaters: A Collaborative Conservation Plan for the Town of Sanford, Maine

More Information: <http://swim.wellsreserve.org/results.php?article=828Conservation%20Strategy%20September%207,%20202010.pdf>

The Town of Sanford, Maine is located at the headwaters of five critically important watersheds in southern Maine and New Hampshire. Using community input and science-based conservation principles to implement the conservation goals of its comprehensive plan, the town is protecting these regional resources. Over the course of three stakeholder workshops, and using innovative GIS and keypad polling techniques, the community developed the following core conservation values:

- Water quality protection.
- Conserving productive land for agriculture.
- Conserving significant wildlife habitat and biodiversity.
- Protecting human health and safety through conservation of floodplains, water supply buffers and wetlands.
- Conserving scenic, cultural and recreational resources.

The community recognizes that these values are provided by Sanford's green infrastructure. Using a GIS software program called Community Viz (www.communityviz.com), the community mapped the green infrastructure that is important for protecting each of these values (Figure 5-8). Once this community-based assessment phase was completed, the town developed recommendations and strategies for protecting each of the five conservation values. One of these strategies was to identify "focus areas" by considering the relative importance placed on each conservation value by community members. Keypad polling techniques, which use electronic keypads (similar to television remote controls) to allow large numbers of community members to place their vote

on which conservation values are most important to them, were critical for ensuring participatory decision-making without slowing down the process. The focus areas were identified from the polling results, which are automatically tallied by a computer and displayed through a projector. These high-priority conservation sites were evaluated for the amount of protected land that they currently contain and the specific threats posed to each focus area by human activities. These focus areas are considered the priorities for action.

Outside of the focus areas, there are additional locations that contain one or more of the five conservation values. These areas were prioritized for protection based on a ranking of land parcels according to their relative value. For example, a parcel containing both exemplary wildlife habitat and water resources would receive a higher priority for protection than a parcel that only contains wildlife habitat.

The following strategies were identified as options to implement the Sanford conservation plan:

- Fee simple purchase.
- Conservation easements.
- Conservation subdivisions.
- Current use program.
- Land use ordinances.
- Community education and outreach.

Responsibilities for implementation of the plan were assigned to each participating stakeholder group, funding sources were identified, and a monitoring and evaluation process was put in place to ensure effectiveness of the plan.

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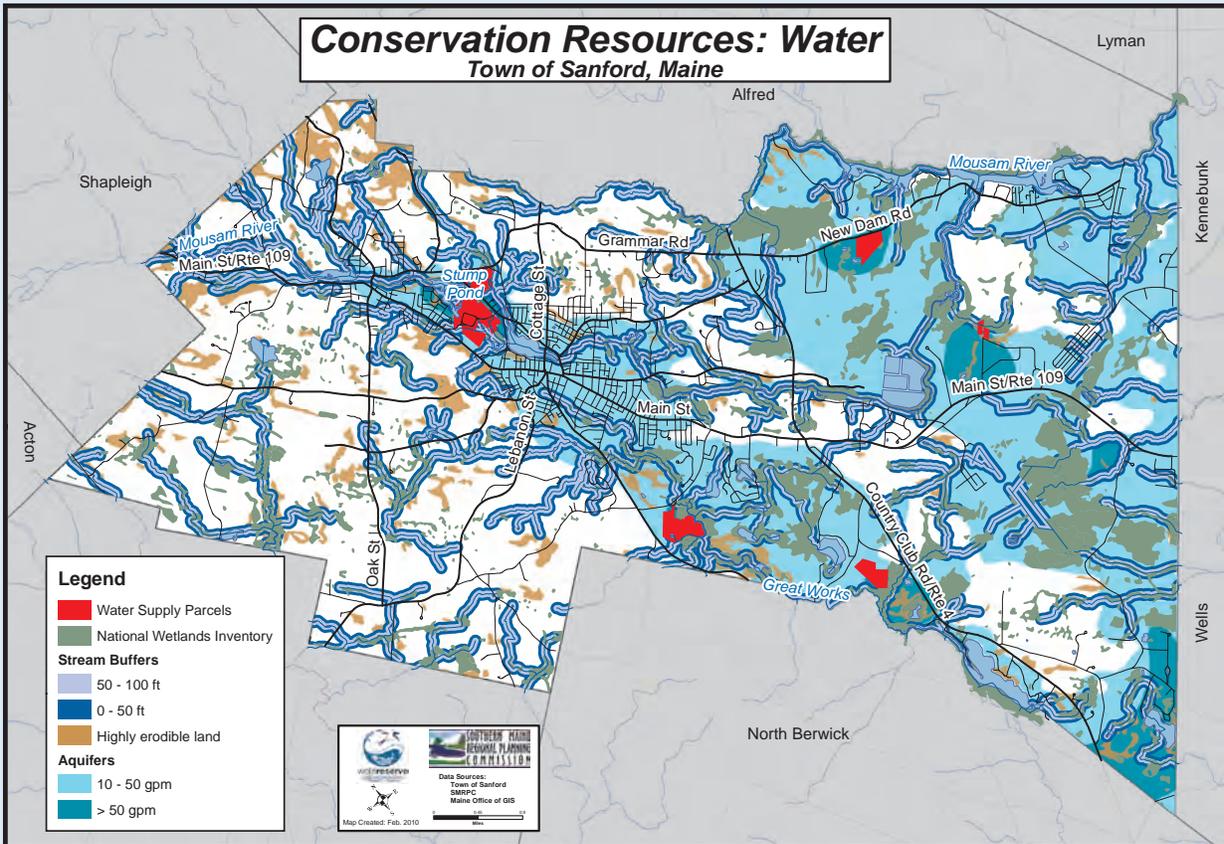
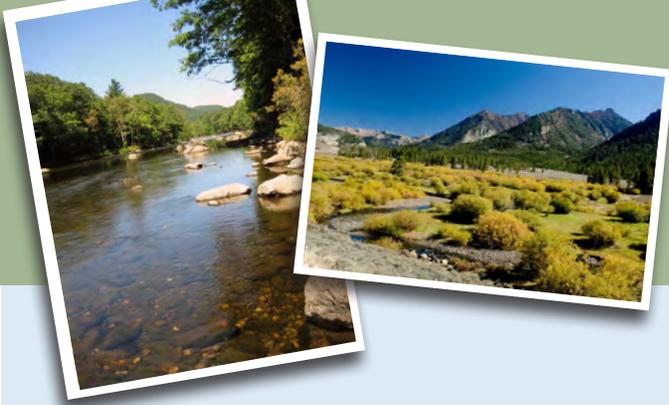


Figure 5-8 Green infrastructure identified for water quality protection (Wells National Estuarine Research Reserve; Southern Maine Regional Planning Commission, 2009)

Case Study



Lower Meramec Drinking Water Source Protection Project

More Information: <http://cloud.tpl.org/pubs/landwater-lowermer-swp-brochure.pdf>

The U.S. Forest Service and the Trust for Public Land (TPL) initiated the Lower Meramec Drinking Water Source Protection Project to expand the reach of forest protection projects in drinking supply watersheds in the northeastern United States to the Midwest region. The Meramec River is a drinking water source for the City of St. Louis, Missouri and its suburbs. Although the river's water is currently high-quality, the watershed is highly susceptible to degradation due to development pressures. Preserving the natural land that drains into drinking water supplies is an ecosystem-level strategy for protecting water quality. In addition to providing drinking water, the Meramec River provides wildlife habitat and recreational opportunities.

The Meramec River Tributary Alliance, a partnership of more than 30 organizations interested in protecting the river, provided local knowledge over the course of the project. In the first phase of the project, the U.S. Forest Service, TPL, and the Meramec River Tributary Alliance refined the project area to focus on the Fox-Hamilton-Brush Creek watersheds. GIS data layers were used to score 30 meter landscape cells for their physical characteristics, such as proximity to water features, and current land use. Raw scores were used to produce a conservation priority index map (Figure 5-9) and a restoration priority index map. Local units of government and real estate experts use these maps to identify opportunities for land protection, restoration, and implementation of stormwater best management practices. The project steering

committee also developed a brochure describing the project for local governments, water suppliers, and conservation groups to use and distribute.

The project's second phase, referred to as the strategy exchange, took place over the course of five days. The strategy exchange was a discussion of drinking water source education, stormwater best management practices, septic system improvements, and land conservation with state and local governments, as well as other local actors. As an outcome of the exchange, regional and national experts contributed strategy recommendations to a report addressing these four topics.

In the project's third and final phase, subcommittees of the Meramec River Tributary Alliance incorporated the exchange team's recommendations for each of the four topics into action plans for immediate implementation that included both voluntary and regulatory or enforcement tactics. Although low-budget tactics were identified, some tactics will require additional funding for implementation. The land conservation subcommittee has started to implement recommendations from TPL's conservation finance team to attract and retain funding for land acquisition. Successful implementation of the action plans will protect the ecological integrity of the Lower Meramec so that it can provide not only clean drinking water, but also all of the diverse services Meramec River Tributary Alliance member groups have individually set out to protect.

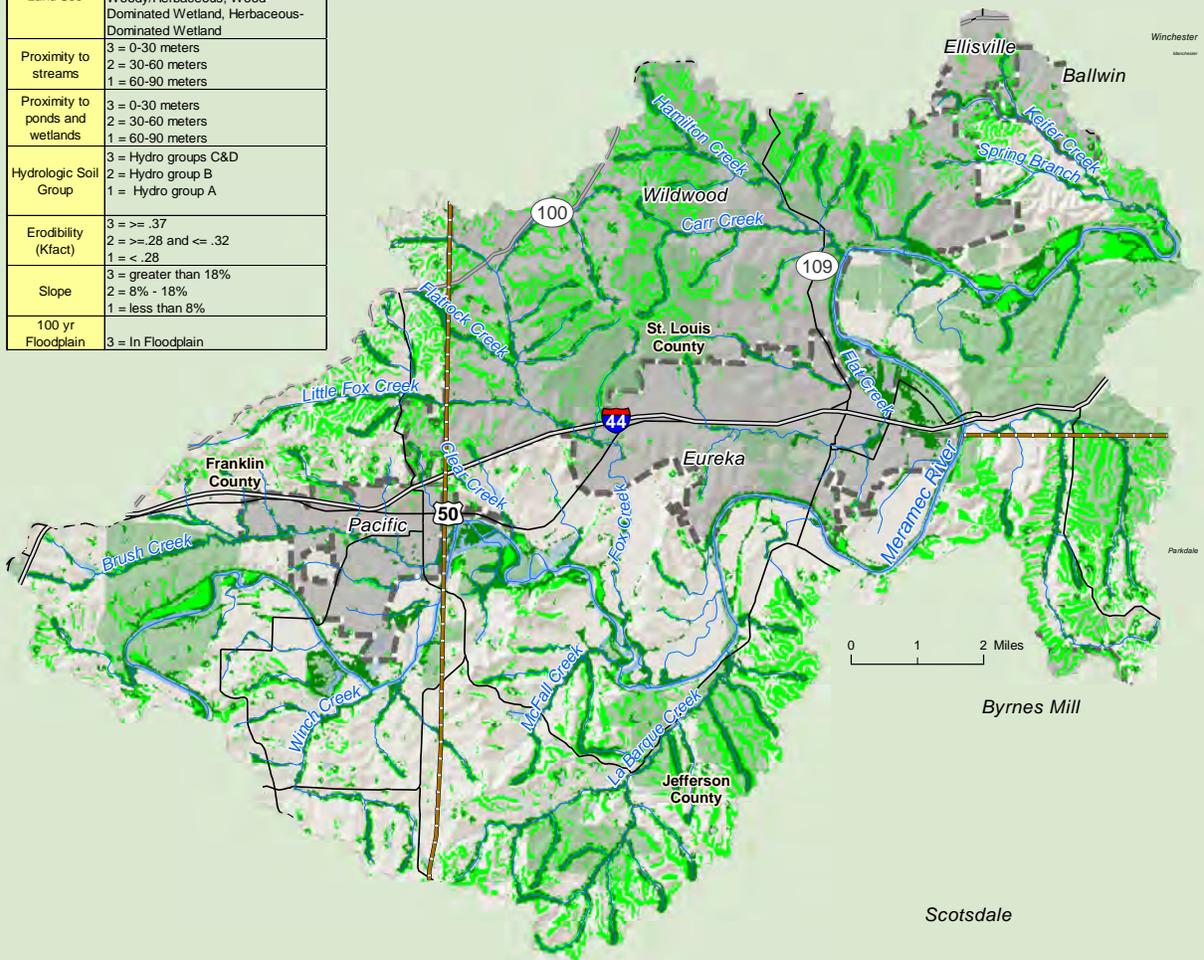
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Lower Meramec Drinking Water Source Protection Project Conservation Priority Index (CPI) Areas

May 5, 2009

Scored on 0-3 scale	CPI Conservation Priority Index
Land Use	3 = Deciduous Forest, Evergreen Forest, Deciduous Woody/Herbaceous, Wood-Dominated Wetland, Herbaceous-Dominated Wetland
Proximity to streams	3 = 0-30 meters 2 = 30-60 meters 1 = 60-90 meters
Proximity to ponds and wetlands	3 = 0-30 meters 2 = 30-60 meters 1 = 60-90 meters
Hydrologic Soil Group	3 = Hydro groups C&D 2 = Hydro group B 1 = Hydro group A
Erodibility (Kfact)	3 = >= .37 2 = >=.28 and <= .32 1 = < .28
Slope	3 = greater than 18% 2 = 8% - 18% 1 = less than 8%
100 yr Floodplain	3 = In Floodplain



Legend

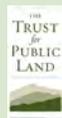
- CPI 90th percentile**
- 13 - 21
- CPI 70th percentile**
- 12 - 21

- Protected Land
- Meramec River
- City Boundary
- County Boundary
- Rivers and Streams

- Interstate
- Highway
- Local Road



Based on the Watershed Management Priority Indices (WMPPI) Model developed by the Forest to Faucet Partnership in collaboration with USFWS, USFS, and TPL. <http://www.wetpartnership.org/>



L, The Trust for Public Land, and The Trust for Public Land logo are trademarks of The Trust for Public Land. Copyright © 2009 The Trust for Public Land. www.tpl.org Information on this map is provided for purposes of discussion and visualization only.

Figure 5-9 Map of Lower Meramec Drinking Water Source Protection Project Conservation Priority Index Areas (Trust for Public Land, 2010).

Case Study



Cecil County, Maryland Green Infrastructure Plan

More Information: <http://www.conservationfund.org/sites/default/files/CecilCounty01.22.08.pdf>

The Conservation Fund is a national organization that partners with local communities to help them fulfill their conservation priorities. In 2007, The Conservation Fund partnered with Cecil County, Maryland to develop a green infrastructure plan. This plan includes a green infrastructure network design, water quality maintenance and enhancement analysis, ecosystem services assessment, and implementation quilt analysis. As described in Chapter 3, a green infrastructure assessment identifies a network of lands, composed of ecological core areas and corridors connecting these hubs. The water quality and ecosystem service assessments demonstrate the importance of protecting the green infrastructure network. For example, 81% of the value of the county's ecosystem services (\$1.7 billion/year) are contained within the network. The implementation quilt analysis outlines a comprehensive approach to protection of Cecil County's green infrastructure network. Specific protection strategies were identified to address the county's tremendous growth rate and land use change and the fact that only 23% of the network is in some form of protected status.

Based on the assessment, a number of strategies for protecting water quality were identified. Sixteen Conservation Focus Watersheds were identified where existing land cover is greater than 50% forest and wetland (Figure 5-10). Natural land cover in these priority watersheds could be maintained through comprehensive plan objectives, performance zoning standards, and other land use planning programs. Ten Reforestation Focus watersheds were also identified. These watersheds have between 30-40% forest and

wetland cover and thus have high ecological capacity for recovery. Agricultural BMPs such as riparian fencing, nutrient management, reduced phosphorus in animal feed, and conservation tillage were also identified as management measures for improving water quality. A comprehensive zoning program using performance standards for site plan review was recommended for improving development site design. The performance zoning code would reward projects using LID techniques.

In addition to the management strategies already identified, the implementation quilt analysis identified additional opportunities for protection. These include use of Program Open Space funds for acquisition of high priority properties in the green infrastructure network; purchase of conservation easements through the Rural Legacy Program; participation in the Maryland Agricultural Land Preservation Foundation's Agricultural Preservation District program; donation of conservation easements through the Maryland Environmental Trust program, which provides tax credits and other incentives to donors of easements; and a number of federal programs. The County also recently implemented a Transfer of Development Rights and Purchase of Development Rights program to protect ecologically valuable lands from development. The Conservation Fund specifically recommended that Cecil County enhance its cluster development option and create a Green Infrastructure Network Overlay with performance standards in its zoning. The County is now using the Green Infrastructure Plan as an advisory document in its comprehensive planning process.

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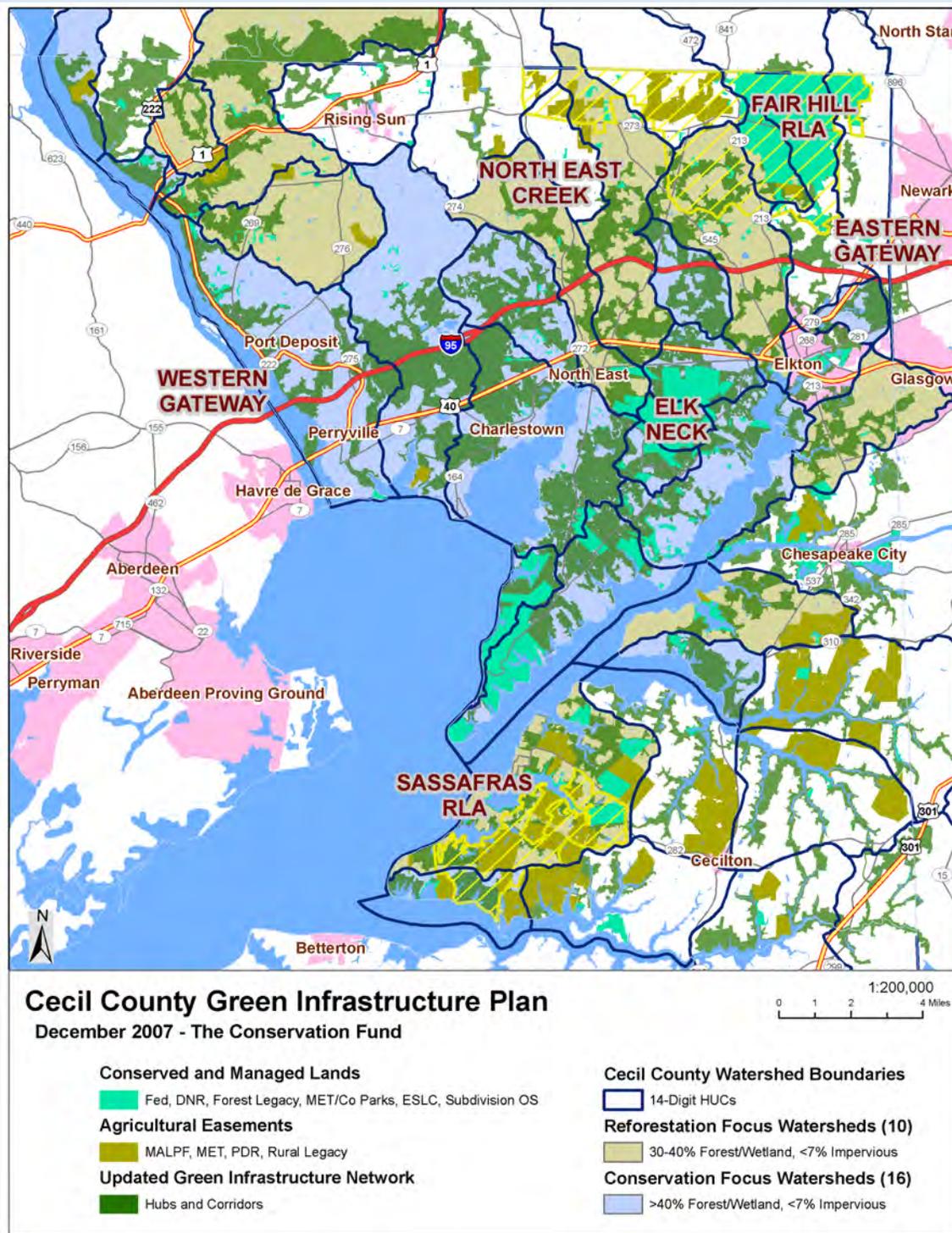
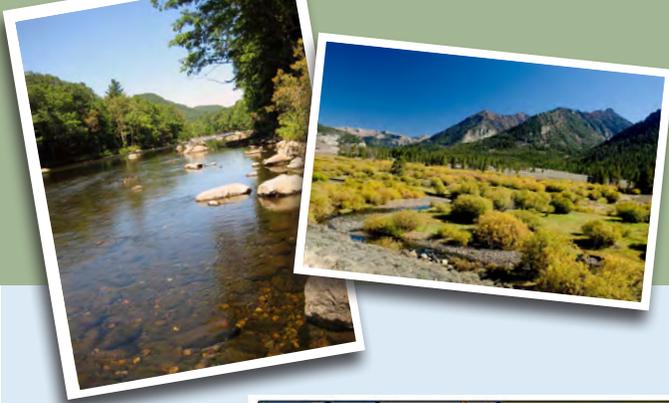


Figure 5-10 Map of Cecil County Green Infrastructure Plan (Will Allen, The Conservation Fund, Personal Communication).

5.2.4 Other Protection

Sustainable Agriculture

Agriculture is an important economic and cultural activity in many communities across the United States. Similar to residential development, careful management of agricultural areas can ensure that the aquatic ecosystem is not degraded and that terrestrial habitat is maintained. Designing a green infrastructure network is one method of identifying the most critical lands to protect from conversion to agriculture and can also include certain appropriate agricultural lands as cultural protection priorities. The USDA National Organic Program develops and implements standards for organic agricultural



products in the United States. Organic agriculture avoids the use of synthetic pesticides and fertilizers, both of which impact water quality. It also reduces erosion and sequesters carbon dioxide in the soil. Individual growers and producers can contact accredited certifying agents in their states to become certified (U.S. Department of Agriculture, 2009). Participation in certification programs can help to ensure that agricultural activities are conducted in an ecologically sensitive manner.

Sustainable agricultural management practices include nutrient management, which refers to the application of fertilizers in appropriate amounts and at appropriate times; conservation tillage or continuous no-till; cover crops to reduce erosion and keep nutrients in the field; and vegetative buffers, which protect aquatic ecosystems from agricultural runoff and provide wildlife habitat. The Conservation Effects Assessment Project is a multi-agency effort to evaluate and quantify the effects of these and other agricultural conservation techniques on the environment. The USDA leads this effort, which focuses on watersheds, wetlands, and wildlife. The USDA also leads the Environmental Quality Incentives Program, Conservation Reserve Program, Wetlands Reserve Program, Wildlife Habitat Incentives Program, Conservation Security Program, and Grassland Reserve Program, all of which are described under Section 5.3.

Sustainable Forestry

Forestry is an important economic and cultural activity in many parts of the country. Organizations such as the Forest Stewardship Council provide certification of sustainable forestry practices in the United States and abroad. The Sustainable Forestry Initiative is an independent organization, originally developed as a program of the American Forest and Paper Association, which works to improve sustainable forest management practices through third-party certification audits. The principles of the Sustainable Forestry Initiative include requirements for sustainable forestry practices, long-term forest health and productivity, prompt reforestation, protection of water quality and the promotion of sustainable forestry on private nonindustrial lands (Barneycastle, 2001).

Invasive Species Control

When a non-native species is introduced into an ecosystem, it can cause a tremendous amount of damage to native species. This is because the native species evolved over hundreds of thousands of years to compete with the unique combination of other species native to its ecosystem. When a non-native species is suddenly introduced (i.e., through human intervention), the native species do not have time to evolve strategies to compete. Additionally, if ecosystems are degraded, it is easier for non-native species to take hold. Many such introductions do not cause significant harm. However, a number of introduced species become invasive, which means that they are directly harming or outcompeting native species. Invasive species can decrease biodiversity and ecosystem resilience. Many of these species, such as Salt Cedar, replace native vegetation and form monocultures (stands of only one tree species). Salt Cedar specifically replaces native riparian vegetation such as willows and cottonwoods and also uses a tremendous amount of water. It uses so much water in fact, that it can lower ground water levels to such a degree that instream flows are affected and native vegetation is unable to reach the subsurface water for its own nourishment. The best strategy for controlling invasive species is prevention. Education campaigns about invasive species are key to prevention. Even simple signs at public boat landings can help. Once an invasive species becomes established, it is difficult to eradicate. Early detection and action is critical. Chemical, mechanical, and biological control techniques exist for eradication. The most extreme cases may require restoration actions, such as controlled burning to remove the non-native species, followed by reintroduction of the native species.

Ground Water Protection

Any approach to healthy watershed management should incorporate ground water in addition to surface water components. In the case of ground water dependent ecosystems (GDE), direct habitat protection, ground water discharge to the GDE, and the temperature and chemistry requirements of ground water supplying the GDE must be considered. Specific management strategies can be identified to protect each of these attributes. GDE habitats can be protected by establishing buffer zones to separate them from resource extraction and trampling. Ground water discharge to GDEs can be protected by establishing maximum limits for ground water extraction or establishing minimum distances from GDEs from which ground water wells could be sited. Ground water quality can be protected by limiting or eliminating land use activities in recharge zones that could impact water quality. To date, most ground water management in the United States has largely been developed and implemented with the objective of protecting ground water supplies for human consumption. Additional focus is needed to ensure protection for GDEs.

Protection of Ground Water Dependent Ecosystems on Range Land

In many regions, focused discharge of ground water to the surface supports critical biodiversity. On at least a seasonal basis, in the semi-arid western United States, these GDEs may have the only available water. When located on range land, the water and associated wetland vegetation make GDEs very inviting to livestock and can result in the damage or destruction of these features.

In order to protect the integrity of GDEs on range land, the Forest Service and others have developed techniques to limit the effects of grazing. Since the availability of water is critical to the success of ranching in many areas, any approach to protecting GDEs should address the need for livestock to access water. One approach the Forest Service has used with some success involves the development of a small-scale water diversion or withdrawal from the GDE, the siting of a stock tank or trough at a distance outside the GDE, and the development of an enclosure fence surrounding the GDE to exclude livestock from the GDE itself.

This approach accomplishes several key range management goals, including: discouraging livestock use of the GDE by providing a consistent, readily available source of water away from the spring; allowing for a better distribution of livestock across the allotment by reducing the incentive to congregate at the GDE; taking pressure off of the sensitive soils and vegetation adjacent to the water and improving overall GDE conditions by limiting grazing effects; improving water quality by improving soil and vegetation conditions within the GDE and eliminating livestock excrement from the water; and improving water availability to wildlife.

5.3 Restoration Programs

Restoration strategies are an essential component of managing healthy watersheds. As development pressures have expanded their reach to more and more pristine landscapes, entire healthy watersheds are less common. In addition, even the watersheds that can be classified as healthy often have room for improvement. For example, a healthy watershed may contain culverts. Replacing a dropped or undersized culvert with a larger, open-bottom culvert will enhance fish and wildlife passage along the stream. When planning restoration efforts, it is generally helpful to consider the “protect the best first” strategy. This strategy prioritizes restoration of the systems that are most likely to maintain their health post-restoration (as in improving healthy watersheds) before investing resources in systems that may be degraded beyond their recovery potential.

Much of aquatic ecosystem restoration to date has focused on the symptoms, rather than the causes, of ecosystem degradation. Altered geomorphology, impaired water quality, and degraded biotic communities are typically the result of processes occurring in the watershed. Restoration of stream channel form must begin at the watershed scale, focusing on *processes* such as watershed hydrology and sediment supply. Restoration of water quality must focus on the landscape condition that is affected by the socioeconomic drivers of land use. Restoration of biotic communities must focus on the natural flow regime necessary for the different life stages of the aquatic biota, the physical habitat determined by the geomorphic condition, and the water quality that is largely determined by the landscape condition.

Ecological restoration is a new and growing field that, broadly defined, seeks to return degraded ecosystems to a state closer to their original, natural conditions. EPA’s Principles for the Ecological Restoration of Aquatic Resources (2007a) emphasize, amongst other things, working within a watershed or landscape context, restoring ecological integrity based on a system’s natural potential, and the use of passive restoration and natural fixes. A system’s natural potential can be determined in a number of ways, including the use of appropriate reference sites for the ecoregional setting. Passive restoration refers to a reduction or elimination in the sources of degradation, as opposed to active approaches such as alum treatment. There are cases when active restoration is necessary, but passive restoration is often sufficient and more cost-effective. In addition, active restoration can sometimes have unintended and unforeseen effects on other system components. A small sampling of national, state, and local restoration programs are described below.

5.3.1 National

The National Fish Habitat Action Plan is a nationally linked, yet locally driven effort to improve fish habitat across the country (www.fishhabitat.org). Fish habitat partnerships are formed voluntarily and collaborate to protect, restore, and enhance fish habitat through, federal, state, and locally funded projects.

The National Fish Passage Program was initiated by the USFWS to reconnect aquatic species with their historic habitats. Through the National Fish Passage Program USFWS leverages federal funds to secure donations from partners and provides technical assistance to remove or bypass artificial barriers to fish movement.

The Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners and tribes who agree to work with the US Fish and Wildlife Service and other partners on a voluntary basis to help meet the habitat needs of Federal Trust Species (migratory birds; threatened and endangered species; inter-jurisdictional fish; certain marine mammals; and species of international concern).

The Restoration Center is the only office within the National Oceanic and Atmospheric Administration (NOAA) devoted solely to restoring the nation’s coastal, marine, and migratory fish habitat. They fund and implement restoration projects to ensure healthy, productive, sustainable fisheries; employ technical staff to help improve project design, ensure environmental compliance, and advance restoration techniques; engage the local community and encourage stewardship of the nation’s coastal habitat; fund projects that engage local people and resources, supporting the economy through restoration activities, expertise, and materials; collaborate with public, private, and government partners to prioritize projects and leverage resources; use

scientific monitoring to evaluate restoration project success and maximize the use of tax dollars; and conduct socioeconomic research that demonstrates the benefits of coastal restoration for community and environmental purposes.

Total Maximum Daily Loads (TMDL) are a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. They are watershed assessments that are conducted for impaired water bodies as designated under section 303(d) of the Clean Water Act. TMDLs are required for all pollutant-impaired water bodies and can be considered the beginning of a watershed restoration plan focused on water quality. Most TMDLs now use a watershed approach for assessment and implementation. However, implementation of a TMDL and watershed restoration plan is critical if water quality is to be restored.

The Nonpoint Source Management Program was established under section 319 of the Clean Water Act to support a variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to design and assess the success of nonpoint source programs and projects. In particular, the program provides funding for the implementation of TMDLs and watershed management plans. The watershed management plans, though federally funded, are implemented at the state and local level, typically by county governments, conservation districts, and watershed councils.

The Conservation Reserve Enhancement Program is a USDA program that protects ecologically sensitive land, wildlife habitat, and aquatic ecosystems through retirement of agricultural lands. The program provides payments to farmers and ranchers who agree to keep their land out of agricultural production for at least 10-15 years. The program has been used to establish riparian buffers, restore wetlands, and create wildlife habitat through reforestation.

The Wetlands Reserve Program, another USDA program, assists landowners in restoring agricultural wetlands. NRCS may fund 75-100% of project costs on lands that are under a permanent conservation easement, and 50-75% of restoration costs on lands under temporary easements or cost-share agreements.

The USDA Wildlife Habitat Incentives Program assists private landowners in creating and improving wildlife habitat through cost-share assistance up to 75% of project costs.

The Environmental Quality Incentives Program is a USDA program that provides cost-share assistance to farmers in implementing various conservation measures including erosion control, forest management, comprehensive nutrient management plans, etc.

The USDA Conservation Security Program provides technical and financial assistance for conservation purposes on working lands, including cropland, grassland, prairies, pasture and range land, and incidental forest lands on agricultural properties.

The Grasslands Reserve Program is a voluntary program to limit future development and cropping uses on grazing lands to support protection of these areas. This USDA program establishes grazing management plans for all participants.

5.3.2 State and Interstate

Restoration of Flow and Connectivity

Historically, straightening and armoring of stream channels was a common practice to protect floodplain development from a meandering river and for navigation purposes. Unfortunately, this practice increases a stream's energy, which is sent to a downstream reach where significant erosion of the stream channel can occur. Depending on the current riparian land uses, it may be possible to remove the bank armoring and allow the stream channel to reclaim some of its original floodplain. Similarly, many dams have been built across the United States over the past 200 years. While many of these dams are essential for providing drinking water, hydroelectric power generation, and agricultural irrigation water, a large number of them have been

decommissioned or abandoned. These dams are often prime candidates for removal to restore the natural flow regime and improve aquatic habitat connectivity. Dam removal projects are a significant undertaking and involve physical, chemical, hydrological, ecological, social, and economic considerations (American Rivers, 2009a). Where it is not feasible to remove a dam, reservoir release rules that mimic the natural flow regime can improve the ecological function of the river (Richter et al., 2006). However, when working in riverine ecosystems that have been highly modified, managers must often rely on site-specific flow-ecology relationships to inform restoration decisions. Some possible strategies identified by The Nature Conservancy for flow restoration include:

- Dam reoperation.
- Conjunctive ground-water/surface-water management.
- Drought management planning.
- Demand management (conservation).
- Water transactions (exchangeable water rights).
- Diversion point relocation.

Aquatic ecosystems are dependent on sufficient instream flows for maintaining their vitality. For example, Pacific Salmon require specific gravels, water depths, and velocities during spawning to build their nests. Alteration of the natural flow regime can change water depth, velocity, and the substrate on which the spawning salmon depend. Anadromous fish, such as Pacific Salmon, also require stream connectivity for migration between the headwaters streams, where they are born, to the ocean, where they live out most of their lives. Where dams and other structures disrupt aquatic habitat connectivity and removal of these structures is not feasible or desirable, fish ladders and other upstream or downstream passage facilities can be used to ensure that fish retain access to habitat (U.S. Fish and Wildlife Service, 2009). This is especially important for anadromous fish species (e.g., salmon, alewife). States such as Oregon, Washington, and Pennsylvania have created fish passage rules that require stream crossings and other artificial obstructions to allow for the passage of migratory fish.

5.3.3 Local

Greenways, discussed in Chapter 2, are recreational corridors of natural vegetation that can be fit into existing developed areas to create or improve wildlife habitat, scenic and aesthetic values, and outdoor activities such as walking, running, and cycling (American Trails, 2009).

Wetland construction and restoration is typically a site-based restoration approach. However, when viewed in its landscape context, wetland restoration can improve wildlife habitat and connectivity, nutrient retention, hydrologic regulation, and pollutant removal. The benefits of wetland restoration are maximized when conducted in a landscape context (U.S. Environmental Protection Agency, 2007c).

Reforestation is a technique that can be conducted at a stand (site) or landscape scale and improves wildlife habitat and connectivity, infiltration of rainfall, and regulation of surface temperatures. Riparian reforestation can be especially beneficial to aquatic ecosystems, as riparian forests are important components of the Active River Area. Riparian forests in headwater catchments provide coarse particulate organic matter and large woody debris that supply the unique assemblage of organisms in headwater streams with the food and habitat they require. Organisms in lower reaches of the watershed depend on this upstream supply of energy as well. Floodplain forests in the lower reaches of the watershed provide valuable spawning grounds for some aquatic species during floods, provide habitat to terrestrial and semi-aquatic species, serve as buffers to attenuate nutrient delivery to the streams, and provide shading to the aquatic habitat which regulates water temperatures (Center for Watershed Protection; U.S. Forest Service, 2008b).

Meeting Urban Water Demands While Protecting Rivers: Rivanna River, Virginia (Richter B. , 2007)

The Rivanna Water and Sewer Authority, working with The Nature Conservancy, has developed a new water supply plan that meets growing water demands and improves river ecosystem health. The new plan mimics natural flow regimes through controlled dam releases while ensuring adequate water supplies during drought. The releases are calculated as varying percentages of the inflow to the reservoir.

5.4 Education, Outreach, and Collaboration

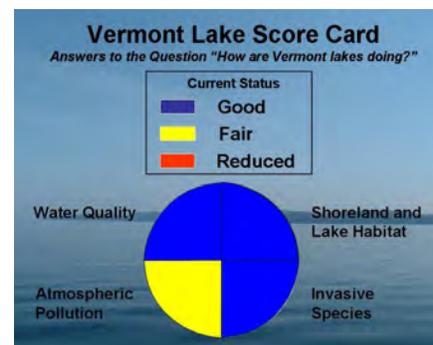
Outreach and education are two protection strategies whose importance cannot be overstated. Efforts to protect healthy watersheds are more likely to succeed if understood and supported by the local community. Communicating the results of healthy watersheds integrated assessments using plain language and graphical elements, such as watershed report cards or simple maps, facilitates the outreach and education process. Most community members will not be interested in fluvial geomorphology or flow duration curves. However, they will be interested in maintaining local fish populations and protecting their properties from flooding. Examples of outreach and education activities include:

- Presentations to local governments and to the general public.
- Newspaper articles describing the benefits of protecting healthy watersheds, and alerting the public to the sensitivity of healthy watersheds to degradation.
- Development and distribution of informative fact sheets or flyers.
- Development of a slide show and script for stakeholders to present with.
- Field trips (e.g., fishing, hiking, canoeing) that enable the public to see and appreciate examples of healthy watersheds firsthand.

Reaching out to the local community and educating stakeholders early in the process can lead to increased support for environmental protection as a result of an increased understanding of the resource and threats, a sense of shared responsibility for maintaining the resource, and cooperation in the implementation of management measures. Examples of actions that communities can take to protect healthy watersheds include integrating green infrastructure and habitat protection into comprehensive plans, protecting the Active River Area from development through zoning, preventing landscape fragmentation through the use of conservation subdivisions, and many other techniques discussed in this chapter. Collaborating with local watershed groups or land trusts can be an effective way to reach community members and share resources in outreach and education campaigns. These groups also often have the capacity and willingness to organize volunteers in performing field monitoring and assessment of water quality, biological condition, habitat condition, etc.

Heal the Bay is a non-profit organization in California that uses a report card approach for communicating the health status of the state's beaches, giving each beach a grade representing the relative risk of fecal coliform exposure posed to beachgoers (Heal the Bay, 2009). A report card approach is also used to communicate the health of the Chesapeake Bay to stakeholders and watershed residents and to increase their awareness of aquatic ecological health (University of Maryland Center for Environmental Science; National Oceanic and Atmospheric Administration, 2009). The report card results are also displayed on a map (Figure 5-11). Another example is the Vermont Lake Score Card that rates the condition of Vermont's lakes with regards to water quality, aquatic invasive species, atmospheric pollution, and shoreland and lake habitat. A similar technique can be used to rate watersheds across a state, county, or region.

A report card, or another format for communicating monitoring and assessment results, can also include information on how local land owners and other stakeholders can help protect or improve the health of their watershed. Providing stakeholders with the knowledge necessary for appreciating the importance of aquatic ecosystems and their watersheds, and tools for protecting those resources, is an important component of healthy watersheds protection. Establishing a local volunteer monitoring network is another potential approach for getting more people involved and concerned about protecting these ecosystems. Such a network could involve training on, and participation in, shoreline monitoring surveys, biomonitoring, water quality monitoring, etc. Annual river cleanups, environmental education campaigns, and meetings or presentations with local communities can all help to increase public awareness and understanding of healthy watersheds.



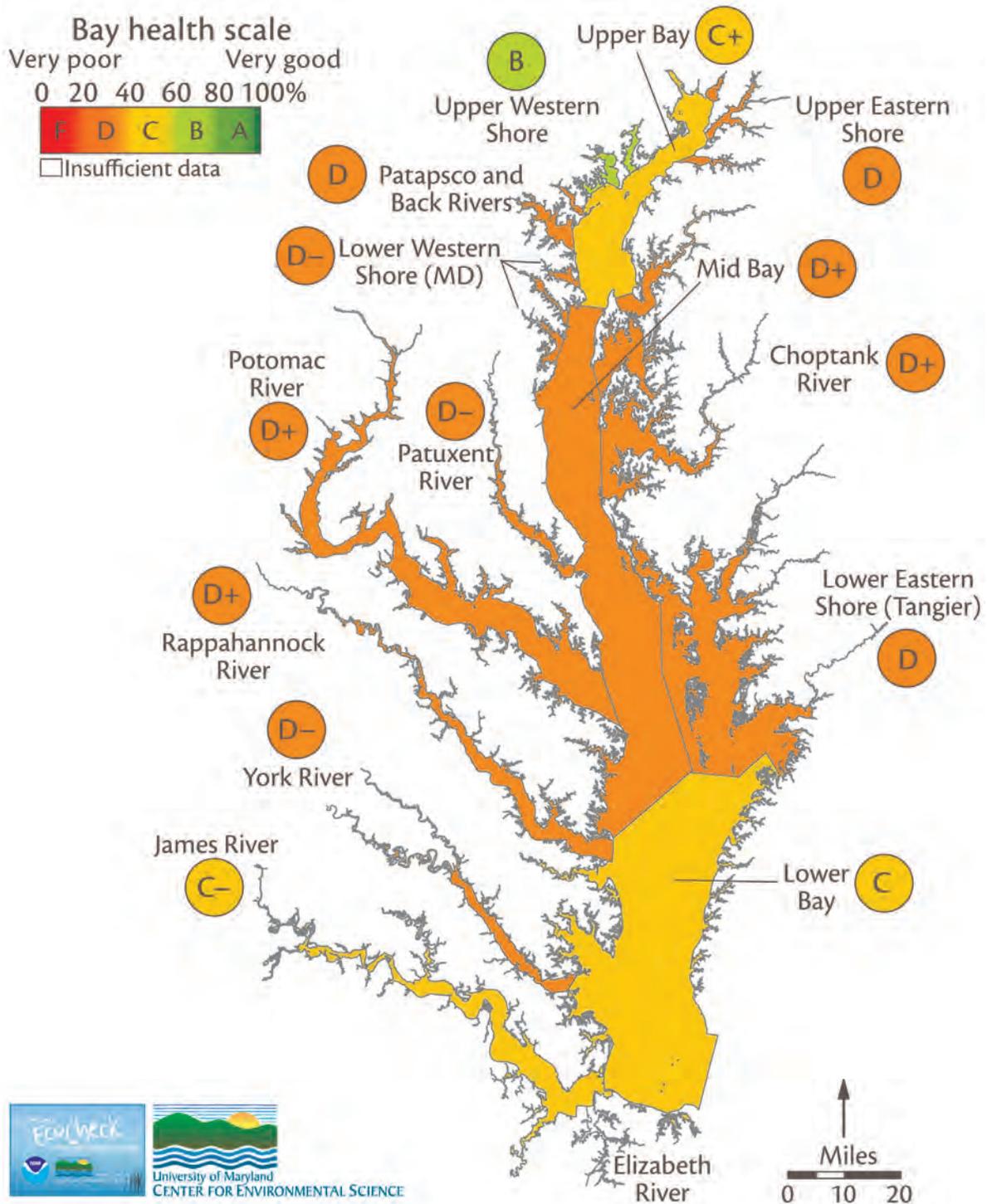


Figure 5-11 Chesapeake Bay report card results for 2007 (University of Maryland Center for Environmental Science; National Oceanic and Atmospheric Administration, 2009).

The various outreach and education options should not be viewed as mutually exclusive. Success in outreach campaigns can be determined by the number of people that hear your message and the number of times they hear it. Exposing people to your message through multiple types of media will help ensure that the message sticks. Tools such as EPA's *Getting in Step: A Guide for Conducting Watershed Outreach Campaigns* (U.S. Environmental Protection Agency, 2003) and Ohio's *Watershed Toolshed* (Ohio Watershed Network, 2009) provide practitioners with the resources needed to get started on some of these approaches. The Conservation Campaign Toolkit (<http://www.conservationcampaign.org/wizard/index.cfm?ID=125>) provides a free online space for communities and citizen groups to organize their campaign to protect land and water resources.

Millions of Americans are outdoor enthusiasts, and many belong to organizations that provide substantial protection to natural resources. Collaboration with outdoor recreation organizations has been shown to increase support for conservation time and time again. For example, Trout Unlimited is a national organization that supports the protection and restoration of coldwater fisheries and their supporting ecosystems. Members belong to local chapters and are often, though not always, recreational anglers. By promoting responsible stewardship of the resource, Trout Unlimited and similar organizations provide recreational and educational opportunities for individuals to participate in the protection of healthy aquatic ecosystems. Recreational use of ecologically intact aquatic systems and their watersheds is an important consideration in the management of healthy watersheds. Encouraging compatible recreational uses often enhances public acceptance and understanding of the conservation process.

Partnerships with less traditional groups can be just as rewarding as outreach to groups that have historically supported environmental protection. For example, the community and public health benefits of protecting healthy watersheds are often valued by groups such as community service clubs, chambers of commerce, religious organizations, and public health advocacy groups. These nontraditional partners can provide access to new audiences and bring new resources to watershed protection efforts. Furthermore, unconventional partnerships can be effective in garnering media attention. When individuals who do not necessarily align themselves with community organizations see the breadth of interests represented by watershed protection efforts, they may be more likely to deem the efforts worthy of their individual support as well. The greater the diversity of groups that collaborate on these efforts, the less likely that the momentum will be lost.