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**WATER QUALITY PROTECTION PROGRAMS  
INSIGHTS FROM SIX EASTERN UNITED STATES CASES**

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## SYNTHESIS

A growing number of water utilities, local governments, and foundations are protecting forested headwaters to ensure sufficient quantities of high-quality water to support healthy ecosystems and human communities. Research on the relationship between land cover—especially forest cover—and water quality is well established in academia (Morse et al. 2018). And, thought-leaders like the World Resource Institute and The Nature Conservancy are devoting increasing attention to documenting and publicizing organizational and financial strategies to help conservation groups carry out land protection programs with water quality in mind (Ozment et al. 2016; Gartner et al. 2013).

However, while the underlying science and institutional knowledge to marry water quality and forest protection are increasingly available to practitioners, both the academic and grey literatures give little guidance on strategies to prioritize and evaluate land protection projects that aim to benefit water quality. Water quality protection programs approach project selection with a mix of science and practical considerations, often operating with little understanding of how their peers function. And, while select methods for targeting land protection for water quality exist, only a handful of evaluations link land protection back to water quality outcomes (Dunn et al. 2013; Southerland et al. 2018) offering little scientific validation for this approach.

To inform the Open Space Institute's (OSI) evaluation of its Delaware River Watershed Protection Fund's impact, in 2018 OSI conducted a series of case reviews of six water quality protection programs to learn how they use science to prioritize forest protection efforts and evaluate the outcomes. Below, we summarize the findings from these reviews, and compare their approaches with those taken by the William Penn Foundation's Delaware River Watershed Initiative.

### Key Findings

- Programs generally simplify science in order keep their prioritization processes comprehensible to board members and partners with limited expertise. Some defer to the expertise of grant recipients to select high-priority projects within pre-existing focus areas.
- Scientific analysis is used more to inform project selection than to evaluate the outcomes. Overall there is an absence of mechanisms to evaluate land protection impacts on water quality. Outside of modeled estimates of the avoided impacts from projected development, there are few clear methods.
- A given program's goal determines the relative ease with which science can be applied for project selection and evaluation. Programs aimed at retaining a filtration avoidance for drinking water within a reservoir system can rely on a stronger set of science to inform the location and placement of land protection projects than programs with a broader scope and geographic extent.
- Programs ranged from single-organization efforts to multi-member coalitions. Coalitions tended to have more complex goals, but also often required that use of science is constrained to ensure it can be used by partners.

## Introduction

Water quality protection programs seek to enhance forested land cover to ensure abundant supplies of clean water for their communities. Whether run by public agencies that allocate resources for land acquisition and stream restoration or by “water funds” that use innovative financial strategies to advance water quality conservation independent of government or philanthropic dollars, they are defining a role for forestland in achieving clean water goals in the United States.

However, even as these programs grow in number and scale, best practices for forestland protection to benefit water quality remain ill-defined. The conventional wisdom that healthy intact forested watersheds yield high-quality drinking water is sound. But, standards for what constitutes a healthy, intact watershed are far from universal, the science linking land use to discrete water quality parameters can be ambiguous, and the relative benefits of investing in restoration versus protection are not obvious to investors seeking tangible outcomes. Further, practitioners struggle to balance scientific rigor with the practical concerns of land conservation.

Here we review six water quality protection programs in the eastern United States to compare their use of science to both develop strategies to improve water quality and evaluate their impact. These funds, selected to represent the diversity of scales, funding sources, and approaches in the field, are:

- Beaver Water District (Arkansas)
- Massachusetts Department of Watershed Protection (DWSP)
- Minnesota Headwaters Fund
- New York Water Quality Improvement Program (WQIP)
- Portland Water District (Maine)
- Savannah River Clean Water Fund (Georgia)

These programs were selected to represent a range of funding strategies, focus areas, and approaches to achieving water quality goals through forestland conservation. Table 1 provides a snapshot of the six programs. We also conducted an internal review of the Delaware River Watershed Initiative (DRWI), using the same questions and criteria. Insights from the DRWI case are presented in boxes, to allow comparisons with the other programs even though, as the client sponsoring this project, DRWI cannot be integrated into the main body of this report.

**Table 1. Comparison of water quality protection programs**

<i>Program</i>	<i>Scale (acres)</i>	<i>Watershed land uses</i>	<i>Conservation targets</i>	<i>Protected to date</i>
Beaver Water District (Arkansas)	762,880	70% forest 2% agriculture 3% developed 21% pasture 4% water	None	>1% of watershed (444 acres)
Massachusetts Department of Watershed Protection, Wachusett focus area	70,678	70.2% forest 1.2% wetland 7.3% agriculture 13.1% residential 1.6% commercial 2.2% open water 4.4% other	None	28.4% of watershed
Minnesota Headwaters Fund	12,864,272	58% forest 15% wetland 14% open water 10% agriculture 3% developed	20,000 acres of targeted land protection	>1% (2,454 acres as of 2016)
New York Water Quality Improvement Program	State-wide	Not applicable (state-wide program)	None	>1%
Portland Water District (Maine)	282,000	84% forest 1% crop agriculture 3% grassland, pasture 7% developed 4% shrub, scrub 1% herbaceous wetland	None (Partner, Sebago Clean Waters, has >76% forest retention goal)	10% of watershed
Savannah River Clean Water Fund (Georgia)	2,289,463	77.6% forest 6.4% grassland 7.2% agriculture 8.9% developed	60% forest retention	None to date

## *1. Setting landscape conservation and water quality goals*

All six programs that we reviewed mention drinking water quality in their overall goals. For some this is the predominant goal; Massachusetts DWSP is an example. Others, like the Minnesota Headwaters Fund, give equal weight to ecological integrity and other co-benefits. Accordingly, our review distinguishes between programs' water quality goals and broader conservation goals. We also note that the publicized goals of a given program may be less nuanced than the more complex understandings of program staff (Box 1).

To achieve their water quality and conservation goals, three of the six programs we reviewed have adopted quantitative targets and stress protection outcomes. The remaining three programs use less rigid qualitative targets to inform their strategy, relying instead on a general assumption that more forest cover yields better water quality. This spectrum raises a question about the role of goal-setting: is one approach more effective than the other in protecting water resources?

OSI's 2018 literature review on the science linking land cover and water quality suggests that using quantitative land-use metrics for conservation activities to benefit water quality is justified. The academic literature shows that water quality impairment begins when watersheds fall below 90 to 60 percent forest cover, with the specific threshold affected by the nature of the non-forest land cover (Morse et al. 2018). For example, 25 percent well-managed farmland may have less deleterious effects on water quality than 10 percent intensive development.

Three programs have adopted quantitative measures of conservation success; generally acres of forest, wetland, or other land cover that protects water quality. The Savannah River Clean Water Fund aims to retain the forested character of the lower Savannah watershed, roughly 78 percent of which was forested at the time of the fund's inception (Krueger and Jordan 2014), by protecting 60 percent of that land area in perpetuity. Similarly, the Minnesota Headwaters Fund has a goal of protecting 20,000 acres of critical importance to water quality in its focus area, as part of a larger effort to catalyze conservation across a broader 100,000-acre region. Taking a slightly different approach, the Portland Water District has not specified a land protection target but instead—in collaboration with regional conservation partners—called for conservation measures sufficient to ensure that 76 percent of the Sebago Lake watershed remains in forest cover (Daigneault and Strong 2018). Collectively, though, the Maine partners use quantitative targets against which to measure progress.

In contrast, Beaver Water District, Massachusetts DWSP, and New York WQIP have qualitative goals. The Beaver Water District and Massachusetts DWSP both seek to protect sufficient area in their source watersheds to ensure water quality, without indicating what a sufficient area might be. And because it funds land trusts and other organizations that prioritize their own projects, rather than implementing projects itself, New York WQIP can be said to take a similarly broad approach. These programs' more loosely worded goals still express a mandate to use forestland to benefit water quality, but without percentages for different land uses or acreage targets. Although a large and relatively stable budget and long operating history have likely helped Massachusetts DWSP achieve its extensive land protection successes, its qualitative conservation goal likely also contributed by allowing for a flexible yet strategic approach to forestland protection.

## ***2. Using science to select and evaluate projects***

The programs' use of scientific metrics to supplement traditional "acres and stream-miles protected" approaches appear limited, and we found considerable variation in the level of scientific rigor for prioritizing projects. While all programs had some scientific considerations in their selection process, the sophistication of analyses used to value projects differed.

The Savannah River Clean Water Fund, Minnesota Headwaters Fund, and Massachusetts DWSP all relied on relatively sophisticated geospatial models to help identify conservation priorities and value projects, and they had necessary expertise to do so. Their models all assessed water quality protection value by the likelihood and likely impacts of land-use conversion: areas where conversion would degrade water quality received higher protection priority. However, variation between models' factors reveals the slightly different interests of each program, ranging from a strict water quality focus to broader perspectives that marry water quality with co-benefits like biodiversity.

The Portland Water District, Beaver Water District, and New York WQIP emphasize flexibility alongside science to inform project priorities. Portland Water District stresses making their selection processes understandable to board members and partners with limited expertise, and New York WQIP allows for their grantee organizations to select high-priority projects within their focus areas based on their own scientific evaluations.

Sophisticated scientific analysis was less evident in the programs' evaluations of conservation outcomes. Most programs primarily rely on simple counts of acreage protected and basic geospatial analysis to track forestland protection progress. Although some, like Massachusetts DWSP, take careful and frequent measurements of water quality in their focus areas, explicit attempts to link forestland protection progress to water quality conditions were absent.

### **Box 2. DRWI's approach to identifying priorities & evaluating success**

DRWI uses sophisticated mapping to identify priority watersheds, and it considers a range of land uses and water quality threats to evaluate parcels within these areas. Although highly systematic, the approach's grounding in science is intermediate, relative to the models formulated by the Savannah River Clean Water Fund and the Minnesota Headwaters Fund. To construct its model, DRWI relies heavily on expert opinion rather than formal literature review or original research specific to the focus area. However, compared with programs with less systematic project selection criteria, DRWI's multi-tiered approach has been challenging for some partners and resulted in Open Space Institute simplifying the project analysis for applicants. At the same time, OSI is considering the opposite tack with regards to project evaluation. Although OSI's Delaware Fund has reported its progress to date using acres of priority water resources protected, it has recently received a grant to quantify the impacts of its land protection work on water quality. This is the impetus for this review.

Rigorous evaluations would require complex modeling and consistent, labor-intensive monitoring efforts. Staff with the Chesapeake Bay Program, which seeks to track the contributions of forestland to nutrient load reduction in the bay, note that many years' worth of monitoring data are needed to make the connection and confirm the benefits of protected land for water quality. Recent work funded by the Healthy Watershed Consortium has found correlations

between forestland and water quality in Maryland landscapes but does not go as far as to establish causation (Southerland et al. 2018).

### ***3. Integrating protection and restoration***

All six programs we reviewed consider restoration an important part of a broader conservation strategy to benefit water quality. But, some were uncertain about how to integrate restoration into funding programs alongside protection. Programs that are considering restoration to complement protection efforts were often motivated by practical considerations, rather than strictly scientific ones.

The Beaver Water District and Savannah River Clean Water Fund take a practical approach to funding restoration. Staff at the Beaver Water District have found that obtaining landowners' permission to engage in restoration activities is often easier and quicker than developing the rapport needed to implement a protection project. The Savannah River Clean Water Fund has shifted to restoration opportunities when there is a budget surplus. Massachusetts DWSP and the Portland Water District recognize the value of restoration—and support restoration work on properties they have protected—but maintain separate funding programs for restoration work.

#### **Box 3. DRWI's approach to protection versus restoration**

DRWI takes an unusual approach to integrating protection and restoration. Like MA DWSP and the Portland Water District, DRWI outsources restoration projects to a separate entity under the same funding umbrella as its land protection efforts. In support of this work, the Initiative has devoted considerable research and time to understanding the link between restoration and protection. DRWI's land protection funding choices reflect this orientation. While tending to focus on protection of forested headwaters, the program also funds permanent protection of stream buffers as a high impact intervention in more degraded watersheds.

Interestingly, none of the six programs drew on the scientific literature to justify their approach to balancing restoration and protection. Such literature is scarce, but a handful of studies do speak to this intersection, finding that strategic protection efforts in impaired watersheds can augment the effectiveness of nearby restoration projects (Merovich et al. 2013). Such studies could be helpful to programs seeking to better understand the complementary benefits of forestland and restoration for water quality. Further details on the science suggesting approaches to integrating restoration and protection work can be found in the literature review, which accompanies this document.

### ***4. Reconciling science with practical considerations***

Most water quality protection programs use practical guidelines to deal with the realities of land acquisition and protection. Practicalities include politics, timelines, opportunity versus project quality, visibility in the conservation market, and the need to accommodate the goals of the funder, board, or landowner, alongside scientific concerns. Although some of our interviewees

were hesitant to speak to the relative importance of these considerations versus scientific factors, we observed that practical guidelines were important to program success.

All programs discuss the practicality of a project following its scientific vetting as part of their selection process, recognizing that forestland protection also involves a business decision. The Minnesota Headwaters Fund explicitly states they seek to make sound funding choices as well as sound scientific ones, and Massachusetts DWSP staff find it important to be seen as player in the land acquisition market. Although New York WQIP's selection process incorporates no formal deal-making factors, staff give grant recipients considerable flexibility to address such concerns after an award has been made. In fact, rigid guidelines can jeopardize project completion. Relatedly, the Savannah River Clean Water Fund's main challenge appears largely based on practical issues around deal making, rather than science.

**Box 4. DRWI's approach to science versus practicality**

For DRWI, land protection staffs apply a scientific screening process to review projects for funding. The process originally required that applicants understand how their projects scored against various criteria and map products developed by Open Space Institute (OSI). Applicants noted that the time and complexity was a deterrent. As a result, OSI has 1) reduced the mapping requirements; 2) worked with applicant organizations to integrate the science into their conservation planning over a yearlong, William Penn Foundation-supported planning phase, and 3) worked with partners to create tools that reduce the burden on applicants to evaluate their projects.

Should programs develop best practices for the practical considerations in vetting projects? Should there be a more systematic approach? This review suggests both "yes" and "no". Rigid funding considerations appear to have hampered conservation progress for the Savannah River Clean Water Fund, suggesting it may be imprudent to overly structure the nonscientific requirements for water quality protection funding. Our reviews revealed two practical factors that could be especially important: the partnership-building potential of a given project, and the relative value of a project in a given year as opposed to its absolute scientific value. We suggest that these factors have significance as a useful standard.

## BEAVER WATER DISTRICT

**Interviewees:** James McCarty, Manager of Environmental Quality, Beaver Water District; Clell Ford, Executive Director, Beaver Watershed Alliance

“Do you have a stream or creek going through the property? Are there good riparian buffers? If not, are there restoration plans in pace?”

—*James McCarty*

### Beaver Water District at a Glance

**Funding source:** Rate-payer appropriation

**Service area:** Beaver Lake Watershed, Arkansas

**Size:** 1,192 square miles

**Forest cover:** 70% forest cover

**Water quality goals:** “to reduce the load of sediment and nutrients into Beaver Lake from the watershed”<sup>1</sup>, in order to avoid increased treatment costs

**Land conservation goals:** No formal goal metrics or target land use thresholds

**Activities funded:** Protection (easement); restoration

The Beaver Water District’s formal source water protection program was initiated in 2006 (Beaver Water District 2012). The impetus for the district’s conservation mission is the need to maintain Beaver Lake’s water quality, measured primarily in terms of chlorophyll-a, Secchi transparency, coliform organism counts, and total organic carbon levels. The district aims to hold these water contaminants below the federal thresholds for drinking water through proactive landscape-scale measures.

To advance this vision, the district allocates four cents per 1,000 gallons sold to support a roughly \$800,000 annual budget committed to a wide range of source water protection activities, including land protection, restoration, and a regional network to drive conservation. This partnership, the Beaver Watershed Alliance, is composed of area land trusts, conservation funders, business interests, federal agencies, and water utilities (Beaver Watershed Alliance 2012). Working in tandem, the district and the alliance respectively fund and implement a shared conservation mission in the Beaver Lake watershed.

The watershed, which spans roughly 1,000 square miles in northwestern Arkansas, is currently heavily forested and minimally developed, with pasture as the primary non-forest land use. However, Watershed Alliance Director Clell Ford foresees the potential for suburban sprawl in the area. A 2009 Tetra Tech analysis supports this concern, predicting an increase in low-density urban development in the watershed, from 2% in 2001 to 18% by 2055 (Beaver Watershed Alliance 2012). Additionally, Water District Environmental Quality Manager James McCarty identifies nonpoint-source pollution from poultry operations, alongside highly erodible soils on major tributaries, as factors contributing to sedimentation and increased nutrient loads in the watershed.

To address the risk of increased nutrient loading, the district funds a conservation program with both protection and restoration elements. Although it does not aim to control the majority of land

in Beaver Lake’s extensive watershed, the district seeks to ensure that as much of the watershed as possible remains forested, especially in riparian areas. In collaboration with two local land trusts, the district supports conservation of forested parcels to prevent land-use change by covering the stewardship costs of easement projects (both donated and purchased).

Complementing its conservation activities, the district also funds restoration projects with the primary objective of limiting sediment as a nutrient delivery pathway to the lake. It aggressively leverages its funding contributions to area restoration projects to raise matches from public partners like the Natural Resources Conservation Service, as well as private entities. Although the district sees a role for both protection and restoration strategies in the watershed, staff note that restoration projects are considerably easier to fund. Relatively quick project timelines, abundant discrete restoration needs, and the comparative ease of securing landowners’ permission to engage in time-limited activities make restoration a more practical investment for the district than protection.

The Beaver Water District keeps careful records of nutrient loads, as well as biotic proxies like algae blooms and, in some cases, stream invertebrate communities in major tributaries, to assess water quality. However, formal efforts to systematically link landscape and water conditions to these metrics remain nascent. The district does not have a specific land protection target or stream restoration benchmarks to guide its work. Instead, it relies on the conventional wisdom that forested drainages with stable riparian areas support healthy biota and yield high-quality water, supported by watershed-specific research linking land use and water quality (McCarty et al. 2018; Giovannetti et al. 2013), and it has monitoring programs to ensure that its water quality goals are being met. In support of these goals, the district focuses on protecting the forested condition of high-quality wooded parcels and mitigating the water quality threats from degraded sites.

## **Project Selection**

“I see where the problems are; what do I need to do to get funding to address those?”

—*Clell Ford, Executive Director, Beaver Watershed Alliance*

The Beaver Water District’s conservation funding process is largely holistic. The Beaver Watershed Alliance, partner land trusts, and in-house specialists collectively identify potential opportunities based on ecological factors and landowner willingness. To refine project selection for both restoration and protection efforts, the district relies on several data sources and research products, in combination with practical considerations.

At the highest level of project planning, the Beaver Water District draws from the Watershed Alliance’s (2012) watershed protection strategy document, updated from a report commissioned from Tetra Tech in 2009. This document identifies watershed impervious area as a major threat to water quality. Based on literature values, the document identifies 10% impervious area as the threshold above which water quality suffers. To address this threat, the district’s companion report outlines a Watershed Protection Strategy that allocates roughly \$215,000 to conservation funding, of which roughly 40% is directed toward supporting easement projects via stewardship costs (Beaver Water District 2012). A 2008 joint mapping effort with TNC and the Arkansas Forestry Commission is also briefly referenced as a source of subwatershed-scale prioritization

for protection and restoration, but this was not detailed further in the document or referred to during interviews with staff. Complementing these high-level resources, the district also draws on in-house GIS exercises that overlay point-source pollution risks from poultry operations and erosion risks from pasture in Beaver Lake tributaries' floodplains (McCarty et al. 2018), to target its conservation efforts. Collectively, this range of research and planning material forms the justification for the district's conservation funding.

To inform project selection at the parcel scale, the district's approach was characterized as "opportunistic." For protection projects proposed by land trust partners, staff consider the land use of a given property, its spatial relationship to major water bodies, and the presence of water resources on the site. These broad ecological concerns are weighed alongside practical considerations like landowner's willingness and the potential to leverage district monies to raise additional conservation funds. Ultimately, staff note that the district rarely turns down protection projects. For restoration efforts, it considers similar ecological factors, but with attention to the potential to prevent future pollution from land-use practices like poultry management or landscape processes like bank erosion. Here, the district also considers the capacity of funding partners to support projects that are in the interests of their core constituents, opting to allocate its own resources where they are most likely to make a significant difference.

### **Tracking Success**

"The easiest way to measure success is that over the long-term data set, we don't see a decline in water quality."

—*James McCarty*

The Beaver Water District tracks its conservation program's success in broad terms. Acreage of land enrolled in easement programs with its two participating land trust partners, and other area conservation groups, forms the core metric for evaluating protection outcomes. Restoration progress is evaluated in terms of linear feet of streambank restoration. In the long term, staff say, these measures would ideally be linked to sustained or improved water quality in Beaver Lake and its tributaries. But the timeframe needed to assess changes to lake water quality makes it difficult to include this measure in year-to-year evaluations of project outcomes.

Beyond biophysical measures, staff identified strong partnerships as a measure of conservation success in the watershed. The Beaver Watershed Alliance's efforts to build a public conservation ethic through education and outreach address one element of this goal. The district's own efforts to catalyze conservation spending by area stakeholders—especially local water utilities—remain an ongoing objective.

## MASSACHUSETTS DIVISION OF WATER SUPPLY PROTECTION, DEPARTMENT OF CONSERVATION AND RECREATION

**Interviewees:** Dan Clark, Regional Director, Quabbin/Ware, DWSP;  
Jim French, Land Acquisition Coordinator, Department of Conservation and Recreation

“The more woodlands and the less impervious surfaces, the better.”  
—*Jim French, DCR Land Acquisition Coordinator*

### MA DWSP at a Glance

**Funding source:** Massachusetts Water Resource Authority ratepayer appropriation

**Service area:** Central Massachusetts Quabbin Reservoir Watershed, Wachusett Reservoir Watershed, and Ware River Watershed

**Size:** 360 square miles over three watersheds (Quabbin, 146 square miles; Wachusett, 116 square miles; Ware, 96 square miles)

**Forest cover:** Average 77% forest cover across three watersheds (Quabbin, 88%; Wachusett, 67%; Ware, 76%)

**Water quality goals:** Remain below trigger thresholds for the U.S. Environmental Protection Agency’s Source Water Treatment Rule

**Land conservation goals:** Continue land acquisition through fee and purchase of watershed preservation restrictions for foreseeable future, with focus on land in Wachusett Reservoir and Quabbin Reservoir watersheds; no specific land-cover type thresholds, but broad preference for maintaining forest cover

**Activities funded:** Protection (easement, acquisition)

The Massachusetts Department of Conservation and Recreation’s Division of Water Supply Protection (DWSP) is a state agency charged with managing the source reservoirs, rivers, and watersheds that provide drinking water to many of the state’s urban areas. DWSP’s conservation program draws ratepayer-derived funding from the Massachusetts Water Resource Authority, which has formally supported land protection in the Quabbin Reservoir, Wachusett Reservoir, and Ware River watersheds since 1991 (Massachusetts Water Resource Authority n.d.). The 1992 Massachusetts Watershed Protection Act provided \$135 million in seed funding to establish a watershed conservation program sufficient to help ensure a waiver exempting the state from requiring gray infrastructure water treatment facilities, pursuant to the Federal Safe Drinking Water Act. More recently, the program has received approximately \$1 million annually from the Massachusetts Water Resource Authority to continue its land acquisition and easement programs (Massachusetts DCR 2018b).

Water quality stressors across the DWSP’s service area vary by watershed. The Wachusett Reservoir, with 14.7% of its area currently in residential or commercial use (Massachusetts DCR 2018b), suffers from the greatest development risk of the three watersheds because of its proximity to Boston and Worcester. In contrast, the Quabbin Reservoir is well protected: DWSP holds extensive property immediately adjacent to the water, only 2.6% of the watershed is in residential or commercial use (Massachusetts DCR 2018b), and its more remote location reduces risk of development. The Ware River lacks a terminal reservoir and instead provides a source for

water transfers as needed. DWSP accordingly permits more public access on watershed lands in the Ware, but that raises concerns of contamination from, for example, vehicle accidents.

DWSP's approach to protecting water quality has been to seek direct management control over as much watershed land as possible, and to supplement this control with a conservation easement program to maintain heavily forested landscapes. Through the agency's own efforts and those of other conservation partners, protected land accounts for 76% of the Quabbin watershed, 45% of the Wachusett, and 51% of the Ware River (Massachusetts DCR 2018b). Department of Conservation and Recreation holdings account for the bulk of protected land in each.

DWSP's conservation programs across the three watersheds have the broad goal of increasing protection on prioritized tracts. The agency purchases land and easements outright and also partners with regional land trusts and other state agencies. The conservation activities are guided by the premise that a forested landscape contributes to high water quality, rather than a percentage or area goal for forest cover. Water quality is monitored in accordance with state and federal standards for biophysical indicators, including fecal coliform levels, turbidity, and sediment transport, and erosion.

## **Project Selection**

“We use the model as a starting point, the internal staff discussion is where we go from there, and honestly, at some point economics comes into it.”

—*Dan Clark, Regional Director, DWSP*

Whether funding an internal or external project, DWSP uses a formal process to guide its conservation investments. Its quarterly project selection process has three stages. First, potential projects are proposed and solicited by staff and partners. Second, project portfolios that highlight conservation values are compiled; projects in the high-priority Wachusett watershed receive additional vetting through modeling (see box). Finally, a DWSP committee reviews potential projects and ranks them according to scientific and practical factors. This approach allows the agency to consider a project's value to its water protection mission systematically and holistically.

The Massachusetts Bureau of Geographic Information's extensive database of GIS layers includes conservation datasets that provide further context on the land protection value of a potential project. Historically, DWSP's model and the GIS review have been the primary basis for decisions about acquisitions and funding, but other considerations enter into DWSP's selection process when the committee weights candidate projects' scientific and practical values. One staff member said, “We might deviate from the model criteria in order to pick up pieces of land that are important to us for other reasons”—they facilitate access to other DWSP interests, say, or they consolidate protected areas by “filling holes in the doughnut.” These “assemblage” values are part of a landscape- rather than parcel-scale strategy. Staff may also raise concerns about projects whose value might be lower than the model's prioritization suggests. DWSP Regional Director Dan Clark cites the importance of the institutional knowledge of long-time staffers and conservation partners, people who have worked in the three watersheds for decades and know the land-use history of prospective properties.

DWSP also considers financial factors when making conservation funding decisions. Although it initially focused its efforts on land acquisition, in the past 15 years it has allocated more funding for easement projects. Easements allow DWSP to protect a greater number of acres at a lower cost and to avoid the payments in lieu of taxes associated with fee ownership. DWSP prioritizes parcels that can be protected or acquired at a discount and has a particular interest in funding conservation of bargain-sale properties and accepting outright gifts of land. Staff help landowners tap into state and federal tax incentives designed to foster gift, or discounted, land conveyances for conservation purposes.

### **BOX: Model Valuation & the DWSP Watershed Index**

The DWSP Watershed Index was developed early in the agency's formal funding program to prioritize conservation projects in the Wachusett Reservoir watershed. Proximity to Boston and Worcester, and the watershed's relatively low percentage of protected area, prompted agency planners to seek a systematic project evaluation approach (Massachusetts DCR 2018b).

To predict a parcel's potential to contribute to water degradation under a development scenario, the Watershed Index uses hydrological, ecological, and spatial factors: proximity to reservoirs and tributaries, adjacency to other protected open space, slopes, zoning, aquifers, sewer infrastructure, wildlife habitat, and risk of development. After developed and currently protected lands are removed from the model input, the remaining parcels are assigned a 1–7 score. Parcels scoring 4 or higher receive priority for conservation funding (Massachusetts DCR 2018b). The Watershed Index is decades old, and a possible update is being discussed.

Clark observes that conservation funding is not an objective process: “there is some art behind the science,” he says of working in a landscape where private ownership predominates. Year to year, the abundance of strategically desirable parcels on the market for conservation funding varies; landowners' willingness to sell property to a conservation buyer or enroll in an easement program is fickle. In a slow year, staff may advocate for funding a relatively low priority property just to keep the department's presence in the land protection community at the top of future sellers' minds.

### **Tracking Success**

“We have to demonstrate [that] we still deserve a waiver from filtration.”

—*Dan Clark*

DWSP tracks its conservation activities using geospatial tools that depict the division's land acquisitions since 1985. Annual reports document additional conservation statistics, including the percentage of watershed land that the agency has a conservation or management interest in, what proportion of that land is directly connected to the water supply system, and the total percentages of protected land and other land uses in the watersheds.

To inform the annual reporting process, staff conduct extensive on-the-ground monitoring in support of several programs that complement their land protection mission. Monitoring of water quality parameters is supplemented by forest health monitoring to inform timber management in the protected watersheds. Across all three source watersheds, water quality in 2017 was documented as excellent (Massachusetts DCR 2018a, 2018c). The agency involves the Massachusetts Water Resource Authority in reviewing annual water quality statistics and conducts as-needed monitoring in addition to scheduled monitoring according to its recommendations. Rigorous water quality monitoring is essential to the Massachusetts Water Resource Authority's continued qualification for a filtration waiver from the Environmental Protection Agency.

DWSP and the University of Massachusetts Amherst's civil engineering department are in discussion about new models that could allow staff to monitor sediment transport and reservoir levels under changing climatic conditions with a growing population and increased development. More sophisticated models might also help identify particularly vulnerable tributaries and other areas with high conservation values.

## MINNESOTA HEADWATERS FUND

**Interviewee:** Richard Biske, Minnesota, North Dakota, and South Dakota Freshwater Conservation Program Director, the Nature Conservancy

“TNC is interested in identifying areas that aren’t impaired yet, and arresting impairment for multiple environmental benefits.”

—Richard Biske

### Minnesota Headwaters Fund at a Glance

**Funding source:** Private investments and public funding

**Service area:** Mississippi Headwaters region of central Minnesota

**Size:** 20,100 square miles

**Forest cover:** 58% forest cover<sup>1</sup>

**Water quality goals:** Broadly defined interest in source water impacts on downstream populations; strategic model ultimately defers to a high-level assumption that certain thresholds of watershed protection will achieve desired water quality levels as a justification for avoiding the use of specific water quality metrics.

**Land conservation goals:** 20,000 acres of targeted source water protection in the Minnesota Headwaters region as part of a larger, multi-partner effort to protect 100,000 acres across several categories of conservation need in the watershed; 100,000 acres of restoration for surface and groundwater quality and quantity.

**Activities funded:** Protection (easements, acquisition)  
Restoration (wetland, floodplain buffer)

Established in 2015, the Minnesota Headwaters Fund is an initiative of The Nature Conservancy (TNC) to use private dollars to leverage public funds as a catalyst for land protection in the headwaters of the Mississippi River. Although TNC has been active in Minnesota’s Headwaters region for more than a decade, the concept of a dedicated funding vehicle to advance conservation in the area is the latest stage in a regional effort to implement a targeted approach to land protection. With \$10 million in private seed funding, the Minnesota Headwaters Fund is now pursuing a \$500 million fundraising target over the next decade from public sources toward the goal of securing working forest and grassland easements in addition to targeted water quality restoration practices across the headwaters region. Although it ultimately aims to benefit water quality through land protection and

restoration, the fund champions a “multi-benefit” approach that uses a GIS model to identify priority landscapes that balance source water quality benefits alongside groundwater, flooding, erosion, and biodiversity criteria. This four-pronged strategy for land protection is expected to benefit water quality and help “bring [diverse partners] together, ideally through an analysis that has something for everyone,” according to TNC’s freshwater program director, Richard Biske.

The Minnesota Headwaters region faces acute threats to water quality from land-use change, with rates of wetland and forestland conversion to row-crop agriculture that are among the highest in the nation (Blackburn et al. 2018). Partners at the Minnesota Pollution Control Agency and Department of Natural Resources have charted links between the percentage of a given watershed in forest or grassland and the nitrogen loading in its major rivers; extensive modeling

exercises have shown that lakes with more than 25% land-use disturbance from forest cover to agricultural or urban land use see elevated phosphorus levels (Shaw et al. 2016). Related peer-reviewed field and GIS research identifies a 40% land-use disturbance threshold as a point of inflection for fish community degradation in Minnesota lacustrine watersheds (Cross and Jacobson 2013).

In the Minnesota Headwaters region, the northern subwatersheds are generally minimally disturbed and yield high-water quality, but increasing agricultural and urban development in the lower reaches of the watershed results in a higher proportion of nutrient-rich waters. Drawing on combined fieldwork and modeling studies (Shaw et al. 2016; Cross and Jacobson 2013), area conservation interests, including TNC and other state and local partners, have broadly agreed on a strategy of restoration in watersheds with greater than 25% forest loss, and land protection in watersheds that are minimally disturbed. The fund's priorities are catalyzing land protection in healthy subwatersheds in areas at risk of water quality degradation, forest disturbance, or land-use change (Blackburn et al. 2018).

The fund supports easement and acquisition projects headed up by partner organization with financial backing, and occasionally purchases land that it then flips to partners like the state. The easement projects that it supports can be traditional forest parcel protection projects in prioritized watersheds, or specially tooled riparian protection easements along priority waterbodies. Although restoration activities factor into strategic conservation planning among watershed partners (Shaw et al. 2016; Blackburn et al. 2018), and although TNC itself recognizes that “restoration and protection go hand in hand,” according to Richard Biske, the fund places a priority on protecting existing natural areas that produce clean water. However, the fund also supports restoration projects in watersheds with limited impairments and the ability to provide multiple benefits, which can be restored to an unimpaired status with modest investment relative to severely degraded areas.

To advance its mission, the Minnesota Headwaters Fund's goal is funding 20,000 acres of targeted land protection in high-quality source watersheds. Collectively, the partners aspire to protect 100,000 acres of watershed area across four categories identified by Minnesota DNR and modified by TNC and the fund: 1) vigilance priorities, lands that harbor important biodiversity; 2) high-end protection priorities, lands that are at high risk of conversion and are in watersheds important for resilience; 3) general protection priorities, lands that are at risk of conversion in a broader geographic focus area; and 4) targeted protection priorities, lands that offer source water benefits and have combined protection and restoration needs (Blackburn et al. 2018).

## **Project Selection**

“We still give ourselves latitude as professionals to make decisions—business decisions.”  
—*Richard Biske*

The Minnesota Headwaters Fund follows a two-stage approach to identifying easement and acquisition projects for investment. First, the fund partners with local conservation groups and state agencies to raise interest in easement and acquisition opportunities through landowner outreach. Second, as potential projects surface, the fund deliberates project value based on a

combination of multi-benefit model analysis and case-by-case consideration of the practical pros and cons of each prospect.

**Box: TNC’s Multi-Benefit Model**

TNC’s multi-benefit model combines a wide range of data layers to create four indexes capturing conservation values across the Minnesota Headwaters landscape. Each index is produced by a model module, described below.

The model’s *biodiversity module* combines layers representing habitat for species of conservation need, like cisco and wild rice; state-wide landscape biodiversity value; lakes of high biological significance; fish community biotic integrity; old-growth and other priority forest types; ecological connectivity; proximity to protected lands; and proximity to water. Collectively, these layers form an index capturing the protection value of a given parcel from a biodiversity perspective. The *drinking water quality module* uses a similar approach to prioritize parcels for protection or restoration. It synthesizes data layers for vulnerable drinking water supply areas; groundwater contamination susceptibility; proximity to main river stems; private well density; and wellhead protected areas. The *flooding and erosion module* predicts potential projects’ contributions to water quality through hydrologic benefits resulting from land protection. It incorporates data layers for reduction of flooding and erosion risks; sediment retention benefits; and upstream wetland storage area contributions. The *groundwater recharge module* uses two data layers to assess a potential project’s contributions to ground water gain: rate of annual groundwater recharge, which reflects a property’s contribution to groundwater supplies; and water-use vulnerability, which reflects the demand for water on a given property.

Collectively, these modules yield a combined score on a 1 – 4 scale that indicates a given property’s conservation value. High overall scores reflect high value across modules, while lower scores may reflect high value in only a single module or an overall low value. The conservation partners can assess the nuances within overall model score to assign protection or restoration priorities within target landscapes.

The fund’s deliberation stage weighs a wide range of factors, from strict scientific criteria to political concerns. Initially, project value is assessed based on TNC’s multi-benefit model. In instances when the model indicates sterling parcel value in terms of source water quality, groundwater, flooding and erosion effects, and biodiversity potential, decision making is simple. “We call them ‘no-regret’ projects when the science says slam dunk,” says Richard Biske. But, he continues, “If the science is incomplete, or if factors like size complicate the decision, we need to make sure it is the right business decision.”

Beyond scientific factors, the fund also assesses potential projects from a business perspective, considering such factors as a project’s potential to build relationships with partner organizations and the political climate in the associated municipality. For example, a high-scoring parcel might not make the cut for funding if it falls within what staff describe as a “no-net-gain” county, where local governments have indicated that their tolerance for losing additional land from the

tax base to conservation has reached its ceiling. In these municipalities, alternatives to public ownership are sought. Alternatively, the fund might prioritize a parcel pitched by an important partner beyond model score alone, in order to participate in a valuable collaboration.

### **Tracking Success**

The Minnesota Headwaters Fund measures progress in terms of both acres protected and the costs of those conservation deals. Minnesota has a robust water monitoring program, allowing the fund to rely on state agencies to track nutrient loads in the main rivers and lakes of the Minnesota Headwaters. The fund considers the conservation community's collective ability to prevent nutrient levels from increasing in the region a broader measure of success, albeit one that it does not track directly.

Beyond land and water quality measures of success, the fund monitors the uptake of TNC's multi-benefit model by other area conservation groups. As the model becomes more popular, staff reason that conservation that advances the fund's core goals will be advanced across the Headwaters region, marking a form of broader cultural success. Similarly, the fund watches conservation investing patterns in the Headwaters landscape to assess whether its own initiatives are catalyzing a larger conservation effort.

These more diffuse measures of conservation success are especially important to the fund in light of what staff consider a major obstacle to using land protection to ensure high water quality in the Headwaters region: a complacent land conservation culture. Biske describes the public and many conservation groups as generally lacking a feeling of urgency about protecting the landscape that supports the Headwaters' rivers and streams. Changing the local conservation community's orientation to the work of land protection and other conservation activity is a major goal for the fund. As Biske puts it, "TNC can't succeed at this on their own; we won't succeed in this if we can't get institutions and communities on board."

# NEW YORK WATER QUALITY IMPROVEMENT PROGRAM

**Interviewee:** Lauren Townley, Research Scientist, New York DEC; Eric Wiegert, Water Assessment and Implementation Chief, New York DEC

## **New York WQIP at a Glance**

**Funding source:** New York Clean Water Infrastructure Act Funding

**Service area:** New York State

**Size:** 54,556 square miles

**Forest cover:** 65% state-wide average

**Water quality goals:** Reduce runoff and pollutants that can contaminate drinking water supplies

**Land conservation goals:** Broadly advancing land protection to benefit drinking water quality across New York

**Activities funded:** protection (acquisition)

The New York State legislature passed the Clean Water Infrastructure Act in 2017 and allocated \$2.5 billion for drinking water infrastructure and water quality protection projects across New York, including \$110 million for land acquisitions. To date, \$30 million of funding has been allocated to these projects through the New York Department of Environmental Conservation (DEC)'s Water Quality Improvement Program (WQIP). WQIP as a whole commanded an

\$87 million budget in 2017 and \$79 million in 2018, with funding competitively allocated between six grant types: wastewater treatment, nonpoint source pollution abatement and control, salt storage, aquatic habitat restoration, municipal stormwater management, and land acquisition. Currently, the fund covers up to 75% of costs for land acquisition projects with demonstrable water quality benefits, according to its application documents. However, because each funding category advances specific conservation goals, we focus on the *land acquisition for source water protection* subprogram.

WQIP does not target an ecologically defined focus area. Instead, it invites conservation groups across New York State to propose focus areas for land protection work. This approach distinguishes WQIP from other public efforts like the Massachusetts Department of Conservation's source water protection program and the New York City Department of Environmental Protection's Catskill and Delaware River conservation work (Sapienza and Rush 2016). A statewide approach offers WQIP the opportunity to catalyze land protection in New York and encourage conservation organizations to consider water quality among their conservation priorities. However, the large scope of the program also presents challenges to identifying and prioritizing projects.

## **Project Selection**

To maximize its efficacy across New York's diverse landscapes, WQIP relies on the expertise of applicants to identify land protection projects within their focus areas—ideally on lands falling within areas prioritized for conservation action by state or federal programs. The program issues a request for applications and solicits project proposals from land trusts and other conservation entities during its project identification phase. WQIP's internal vetting process is oriented toward balancing scientific factors with practical concerns.

WQIP evaluates land protection applications alongside projects in its five other funding categories on a 100-point scale. Two criteria address high-level ecological factors, and the remaining four reflect practical concerns. Protection projects are scored according to six criteria, each of which can be met in multiple ways.

- *Performance measures* assess the project's likely contribution to source water protection and take into consideration factors like proximity to public water supply waterbodies, overlap with New York State's open space plan priority areas or identification within a total maximum daily load or DEC action plan.
- *Source water protection prioritization* assesses property land use, targeting at least 50% of land area in a natural cover type on parcels identified by land trust partners as high-value water quality protection priorities, or parcels identified as such by local conservation districts or planning authorities.
- *Reasonableness of cost* assesses the grantee's financial justifications and the anticipated water quality gains relative to the project's cost.
- *Project readiness* assesses evidence of the landowner's and the partner's willingness to begin the legal process of transferring title and assume monitoring responsibilities.
- *Applicant capacity* assesses the grantee's ability to hold a property for water quality benefits, based on past history with DEC or accreditation through the Land Trust Alliance.
- *Regional economic development* draws on outside expertise from the grantee's regional economic development council to rate the project's ability to contribute to area vitality.

After project selection, WQIP has a degree of flexibility in its contract process and emphasizes practical considerations. As grant recipients work with WQIP to refine their project plans, the program remains open to changes in parcel selection based on landowners' willingness, as long as the conservation value of replacement parcels is comparable to the required grant criteria.

### **Tracking Success**

Only in its second year of funding land protection projects, WQIP's source water protection program has had little opportunity to measure its programmatic success. However, several metrics will be used for internal evaluation going forward, including tracking the number of acres protected and lineal feet of stream frontage restored. Beyond these project-specific measures, WQIP also plans to track the amount of funding allocated to each watershed and to evaluate investments against DEC's ambient monitoring programs data for evidence of sustained or improved water quality.

Alongside its planned biophysical metrics of success, WQIP looks to the broader engagement of partners in the conservation community as a measure of progress. WQIP's source water protection program aims to catalyze interest in source water protection through land protection efforts across the state.

# PORTLAND WATER DISTRICT

**Interviewee:** Laurel Jackson, Water Resource Specialist

“Everything looks really good right now, which is why it is sometimes hard to illustrate what the urgency is... it’s going to be a long game. You have to start now if you want to see results into the future.”

—Laurel Jackson, Water Resource Specialist, Portland Water District

## Portland Water District at a Glance

**Funding source:** Ratepayer-derived funding

**Service area:** Sebago Lake watershed

**Size:** 440 square miles

**Forest cover:** 84% forest cover

**Water quality goals:** Maintain high water quality as determined by nutrient (phosphorus), chemical (dissolved oxygen), biotic (chlorophyll *a*) and physical (Secchi transparency) parameters.

**Land conservation goals:** Increase watershed protected area from 10% to 25% by 2033; maintain at least 76% of Sebago Lake watershed in forest cover

**Activities funded:** Protection (easement, acquisition)  
Sources: Portland Water District (2015); Daigneault and Strong (2018).

The Portland Water District is a century-old utility that manages the drinking water for the Greater Portland, Maine, area’s more than 200,000 residents. The main source is Sebago Lake’s 282,000 acre watershed. The utility has long recognized the importance of source water protection to maintaining Sebago Lake’s exceptionally high water quality and has partnered with area land trusts on an ad hoc basis for decades. However, after the US Forest Service’s *From the Forest to the Faucet* report appeared in the early 2010s, the utility’s board sought a more systematic approach to watershed protection. Today, the Portland Water District uses a set of

land-use and geographic criteria to determine funding allocations for area conservation projects. And it has entered into a partnership with local land trusts and regional, national, and international NGOs—called Sebago Clean Waters—to advance land protection.

The Sebago Lake watershed’s forested character and high water quality face a moderate risk from anticipated development pressure. At present, the watershed is lightly developed, with roughly 7% low-density residential land use. Forest conversion is relatively slow, with 3.5% forest cover loss over the last decades of the 20th century and first decade of the 21st (Daigneault and Strong 2018). Population growth is expected in the Greater Portland area, however (Daigneault and Strong 2018). The challenge for the Portland Water District is increasing the pace of land protection without striking an alarmist tone. While development pressure remains low, the Water District has an opportunity to buffer the watershed against future land-use change and ensure that Sebago Lake continues to provide exceptional drinking water.

Sebago Lake’s high water quality is a natural and financial resource for the region. Because the lake exceeds federal water quality standards, the utility qualifies for a filtration waiver that exempts it from investing in costly infrastructure. Area businesses cite the lake’s exceptional

water in their promotional materials (Willis 2017). And conservation funders see opportunity to showcase water funds as drivers of land protection (Sebago Clean Waters n.d.).

The Portland Water District’s conservation program focuses on protection strategies. It owns outright a small amount of land—roughly 1% of the watershed—and pursues limited land acquisition in the lower watershed when properties within 500 feet of the lake shore or two miles of the utility’s intake enter the market. It allocates significant resources for conservation easements, in partnership with local land trusts. The utility also retains the option to provide limited financial support (approximately 2% of total larger protection project costs) for protection projects with a restoration component, and it operates distinct funding programs for small restoration projects.

### **Project Selection**

“The board has indicated that they are happy with the process we have in place. It’s scientifically sound, but not so complicated that people don’t understand it when you explain it to them.”

—*Laurel Jackson*

The Portland Water district has a three-stage project prioritization approach. First, land trust partners propose potential projects and submit basic information about parcel size and location. A systematic approach to vetting potential projects ensues: utility staff evaluate prospective parcels according to six geographic and land-use criteria. Laurel Jackson characterizes these criteria as “common sense,” given the premise that forests and wetlands contribute to high water quality and the need to communicate with landowners, partners, board members, and other lay collaborators. Depending on the number of criteria that a project meets, and the degree to which each criterion is met, the utility will contribute up to 25% of the total project cost.

Following their systematic review of a prospective project’s land cover and geographic qualities (see box), utility staff summarize the project’s scores and present a report to the board of directors’ Planning Committee, which then recommends projects for approval by the full board. This vetting is geared toward practical concerns, such as municipalities’ attitudes toward land protection. However, Jackson reports that practical factors rarely outweigh biological parameters in project valuation.

### **Box: Assessing Project Priorities**

Portland Water District water resource specialists evaluate potential conservation projects according to six criteria, using in-house GIS analysis:

- 1) Lake proximity. Staff use the National Hydrography Dataset to determine whether parcels fall within 500 feet, within 2,500 feet, or beyond 2,500 feet from surface waterbodies in the Sebago Lake watershed. Lake proximity determines the baseline level of funding a project will receive.
- 2) Forest cover. Parcels with more than 50% forest cover earn an additional 2% of project costs.
- 3) Wetland cover. Parcels that are more than 20% wetland earn an additional 2% of project costs.
- 4) Significant aquifers. Parcels overlapping a significant aquifer by at least 10% earn an additional 2% of project costs;
- 5) Municipality. Parcels in one of the seven towns abutting the lake earning an additional 2% of project costs.
- 6) Additional factors, like significant river frontage or restoration potential, can earn another 2% of project costs.

### **Tracking Success**

The Portland Water District is focused on ensuring progress in land protection rather than linking that progress to water quality data. It shares two land protection benchmarks against which to evaluate progress with other conservation entities in the region. This partnership, Sebago Clean Waters, has established a long-term goal of increasing protected area in the watershed from 10% to 25% in the coming two decades, and it tracks conservation acreage in the watershed. The partnership and University of Maine researchers have identified 76% forest cover within the watershed as the likely threshold needed to maintain high water quality (Daigneault and Strong 2018).

Beyond quantifying acreage, the Portland Water District uses several qualitative measures to track conservation success. Chief among these is the establishment of the Sebago Clean Waters partnership, which indicates that the water district has developed and maintained strong working relationships with area conservation partners, and that interest in using land protection to benefit water quality in the Sebago Lake Watershed is strong.

Utility staff say that continuing to build strong partnerships will be essential to further success. Jackson considers land trust capacity critical to achieving the utility's conservation goals. Accordingly, it aims to help partner land trusts develop capacity and to provide technical support when possible. Although the area's land trusts are well known in the Sebago Lake region, the Portland Water District itself has a lower profile in the conservation community. Accordingly, it has begun outreach initiatives to help its customers appreciate the underlying conditions that contribute to the Greater Portland area's high water quality.

## SAVANNAH RIVER CLEAN WATER FUND

**Interviewee:** Peter Stangel, Member, Savannah River Clean Water Fund Board of Directors, and Chief Operating Officer, U.S. Endowment for Forestry & Communities

“It’s in everyone’s interest to protect natural land cover, particularly forests, in the lower Savannah River Basin to help maintain drinking water quality, local culture, and the region’s long-term economic growth potential.”

—Peter Stangel, Member, Savannah River Clean Water Fund Board of Directors

### SRCWF at a Glance

**Funding source:** Water utility allocations (land protection) and private foundations (operations)

**Service area:** South Carolina–Georgia Lower Savannah River watershed

**Size:** 4,375 square miles

**Forest cover:** 78% forested

**Water quality goals:** Maintain high source water quality throughout the watershed for the benefit of utilities; proactively buffer against degradation of Savannah Harbor water quality

**Land conservation goals:** To maintain the predominantly forested character of the Savannah River watershed, the fund aims to jumpstart the protection of 60% of the lower watershed by protecting the 210,000 highest-priority acres for water quality benefits. The fund also seeks to improve forest management practices on an additional 900,000 acres.

**Activities funded:** Protection (easement); landowner outreach for land management practices

The Savannah River Clean Water Fund was established in 2015 to advance the interests of several water utilities and conservation organizations. Recognizing the Savannah River’s heavily forested watershed’s benefits to water quality, the South Lowcountry Task Force, Beaufort-Jasper Water and Sewer Authority, City of Savannah, and the South Carolina chapter of The Nature Conservancy (TNC) built on the region’s longstanding culture of conservation to establish a funding program for land conservation efforts in the lower Savannah River basin. After entering the partnership, five Savannah River watershed utilities committed a combined \$3.3 million for a three-year pilot project for land protection and related research. Drawing inspiration from the Upper

Neuse Clean Water Initiative in North Carolina, using a targeted literature review to summarize the benefits of forest cover to water quality, and initiating a modeling effort with the South Carolina Nature Conservancy to identify priority landscapes for conservation, the fund began to develop its strategy for watershed protection.

Water quality in the Savannah River watershed is currently high, with dissolved oxygen levels above, and nitrogen and phosphorus below, the thresholds set by local water utilities. The landscape is relatively well forested, at 78%, but the fund sees urban development and forest conversion as threats to the river’s water quality. Although the South Carolina chapter of TNC does not anticipate substantial urban area growth in the next 15 years, models do suggest that the area will see increased housing density, with an attendant increase in impervious area (Krueger and Jordan 2014). Partners also identified growing agricultural interests and industrial land use

as potential threats to water quality in the lower Savannah River watershed. Accordingly, well before the fund's 2015 inception, area conservation partners led by TNC conducted a literature review to assess the science linking land use to water quality and related water treatment costs. Drawing from literature values (Ernst 2004), the effort identified a land-use threshold of roughly 60% forest cover as a target to help maintain high raw water quality.

To ensure that a 60% forest cover threshold is sustained, TNC modelers calculated that an additional 1.17 million acres of forestland in the Savannah River watershed needed to be retained through a multi-faceted approach of securing fee acquisition properties, conservation easements, and forest management plans on top of the current 502,000 acres of protected area. Of this 1.17 million, 210,000 acres were identified as most important to water quality and became the fund's formal conservation targets for permanent protection.

To help maintain healthy forests and their benefits to water quality, the fund pursues a land protection mission in the lower watershed. Acting as a clearinghouse for water utility and other funding, the fund partners with land trusts on both the South Carolina and Georgia sides of the Savannah River to support land protection projects. The fund does not directly engage in water quality monitoring; this is undertaken by area water utilities and other partners. However, it does support scientific research into water quality and aims to allocate its \$1 million annual land conservation budget to projects that meet a high standard of water-quality relevance based on the Watershed Management Priority Index, a TNC model meant to assist the project selection process.

## **Project Selection**

*“The [Watershed Management Priority Index] is best thought of as a representation of how readily land conversion and human activities will translate to the stream and river system.”*  
—*Kreuger and Jordan, 2014*

The Savannah River Clean Water Fund undertakes a three-stage process to prioritize land protection projects for funding. First, it relies on land trusts and other partners to identify projects. It prefers projects that are likely to close in the same year that funding is committed—a limitation stemming from some partner utilities' desire to see their funding allocation invested each year—and their inability to carry funds committed to a project from year to year.

Second, the fund's conservation priorities are guided by a Watershed Management Priority Index model, which determines the water quality value of prospective projects. The WPI was developed by the Savannah by TNC's South Carolina chapter in 2011, following a series of 2009–2010 stakeholder meetings with water utilities, land trusts, and other partners. Parcel priorities are categorized on a 1 – 4 scale that reflects the presumed value a given piece of land has in relation to nearby waterbodies (Krueger and Jordan 2014).

Third, the fund considers additional factors. Many parcels that the model identifies as lower water quality priorities may have other important values, some may be large enough to encompass lands with multiple model scores that must be reconciled. Parcel connectivity is highly valued, as are conservation easement opportunities that are close to water utility intakes.

Because the Savannah River basin is so large, another challenge involves the geographic reach of land trust partners, many of which are fairly small and operate within set focal areas. This latter point affects the fund's ability to evenly approach potential conservation easements across the watershed. Additionally, it considers a host of practical factors in project prioritization on a case-by-case basis. Landowners' willingness is a particularly important consideration, as is the potential to further leverage its limited resources.

### **Box: The Watershed Management Priority Index Model**

The model uses seven geographic and hydrological factors to determine a potential project's contributions to nutrient loading and sedimentation in the Savannah River: 1) *land use*, within the broad categories of forested–natural land cover, agriculture or grasslands–light vegetation, and urban area; 2) *proximity to streams*, with parcels closer to streams scoring higher for water quality significance under a conversion scenario; 3) *proximity to ponds and wetlands*, prioritizing parcels closer to wetlands; 4) *soil hydrologic groups*, prioritizing parcels with low infiltration rates that would produce maximum surface flow in a storm under a conversion scenario; 5) *soil erodibility*, prioritizing parcels with highly erodible soils that would result in maximum sediment movement under a conversion scenario; 6) *slope*, categorized in three ranges of 0–4%, 4–8%, and 9–12%, with high-slope areas receiving highest conservation priority; and 7) situation inside or outside the Savannah's *100-year floodplain*, with parcels inside the floodplain receiving higher priority.

Different combinations of factors feed three sub-models that collectively generate a 1–3 score on three related indexes. The Conservation Priority Index assesses forested parcels in terms of their ability to limit water quality effects through avoided conversion. The Restoration Priority Index assesses conservation value for grassland and areas of sparse vegetation, but otherwise relies on the same six geographic and hydrologic factors as the Conservation Priority Index. The Storm Water Management Priority Index follows the same approach as the other two indexes but focuses on high- and low-intensity developed lands, where impervious area can contribute to high surface flow during major storms.

The fund accepted formal grant requests for the first time in 2018 and is currently fine-tuning its approach to prioritizing conservation projects. Peter Stangel notes that the fund's board of directors is guided by modeling but considers practical concerns when making funding decisions—an exercise in adaptive management.

### **Tracking Success**

*“[The fund’s] primary measure of success is progress toward the goal of helping permanently protect the roughly 210,000 acres that are considered most important to water quality”*

*—Peter Stangel, Member, Savannah River Clean Water Fund Board of Directors*

The fund plans to track its success predominantly in terms of acres protected through conservation easements. It will track easements internally and intends to list protected parcels in the National Conservation Easement Database to enable partners to maximize the value of their conservation planning efforts. It also considers landowner contact and outreach on land management issues as a metric of conservation success. Although water quality is the fund's ultimate goal, it does not formally track any water quality metrics, instead relying on its utility partners and others to perform this work. These partners do not attempt to track water quality improvements associated with the protection of specific parcels, but instead monitor general water parameters.

An overarching challenge for the fund is that larger, more expensive projects often require years to complete. Aligning annual funding with such projects has required flexibility from all partners. Stangel notes that fund staff, directors, and partners have learned important lessons about establishing a water fund of this type and continue to adapt. Key transferable insights from the Savannah River Clean Water Fund's experience include:

- A successful water fund and watershed protection program has many components, including funding sources, easement and acquisition opportunities, and land trust capacity to identify and implement projects. A watershed protection program will only be as strong as each of the components.
- Funding flexibility is crucial to accomplishing protection projects that require time to negotiate and finance. Ideal land protection funding should be available at the onset of the project and for a multiyear period.
- Funds working with multiple water utilities must work with the business practices and challenges of their partners. Discussing conservation partners' capacity and financial needs before approaching funders can ease administrative negotiations.
- A clear understanding of the availability of potential projects at a program's onset is important. Thorough assessment of landowners' interest and land trusts' capacity before developing a funding mechanism is critical.
- Ensuring that all partners know the uncertainties and time-needs associated with large land protection projects is essential. Water fund partners may not initially recognize such risks as landowners' changing willingness.

Stangel considers the fund a work in progress. Although it has faced a range of unexpected challenges, there have been promising successes as well. Its trans-state network, philanthropic support base, and ability to raise awareness about the need for watershed-wide conservation strategies are valuable models for the growing water fund community.

## DISCUSSION & RECOMMENDATIONS

Our review highlights the variation in water quality protection programs' landscape-scale conservation goals and targets, use of science in selecting and evaluating projects, and balance between restoration and protection. The small number of programs in this review requires caution in making generalizations, but when paired with the results of OSI's prior literature (Morse et al. 2018), these cases are helpful in identifying how integrating rigorous science could improve the practice of water quality protection. Here, we offer three key recommendations based on the best practices uncovered in our review.

*1) A balance between scientifically grounded strategies, like the adoption of land cover targets based on the best available literature, and flexible approaches that acknowledge the practical realities of land conservation may advance program success.*

OSI's 2018 literature review indicates that the data demonstrating causality between forestland protection activities and water quality are insufficient. Conservation programs intended to protect and improve water quality, whether as a focus or as a co-benefit, represent a rich opportunity to address this gap by tracking changes in land cover, protected area, and restoration while collecting comprehensive water quality data for use by researchers. Such work could support greater certainty for investments in land protection for ecologically based water quality goals. And in turn, researchers may find opportunities to conduct natural experiments in landscapes managed according to different conservation practices. Such collaborations could be crucial in better understanding and acting on the complex relationships among land cover, land conservation, and water quality to achieve healthier ecosystems.

*2) Most water quality protection programs could adopt quantitative goals for land conservation to benefit water quality, grounded in the scientific literature.*

Acreage and stream mile targets are sufficient to track conservation success in broad strokes, but lack utility in careful planning at the watershed scale. Specific, land use targets—like retaining a certain level of forest cover—can provide an additional point of guidance to programs wrestling with how to balance protection, restoration, and development goals in their services areas. Importantly, while the programs we reviewed that adopted specific land use measures presented these benchmarks as “thresholds” below which they aimed to prevent forest cover from falling, the scientific literature challenges this approach. Watershed researchers note that targeting broader “bands” or “ranges” of land cover types better reflects complexities like the potential for different intensities of use within the same cover category, and can help planners avoid the pitfall of pursuing an overly narrow goal to the detriment of water quality.

*3) There is a clear need and opportunity to develop methods to evaluate the impacts of land protection programs on water quality including integrating land protection efforts with long-term research to more thoroughly understand the interplay between conservation strategies and water quality.*

However, the barriers to this kind of integration are often daunting. The timeframe for measuring the in-stream benefits from land protection is much greater than that associated with the better-understood field of restoration. This points to the need for

embedding academic studies with long term funding programs. As a still-maturing field, the world of water quality protection programs has yet to demonstrate the necessary longevity. At the same time, the community's relative newness presents opportunities to involve researchers early on in the life of conservation funding programs and set the stage for the kind of rigorous evaluation measures needed to advance both scientific and practical knowledge moving forward.

The appetite for strategies to achieve water quality benefits while furthering the work of land conservation is abundant, evidenced by the increasingly large community of programs focusing on this interplay and the growing scientific and gray literature—to which this report contributes. And, the potential to advance the state of practice with new research geared towards answering the questions that early efforts of water quality protection programs have raised is strong. Yet, some readers may reach the end of this report and wonder “so what?” Land protection that contributes to water quality has been happening for decades, absent a flexible approach to balancing practical and scientific factors in project prioritization, or a complete understanding of the relationship between strategy and outcome.

We argue that such a perspective misses a key contribution to the joint goals of healthy water and healthy forests that conservation programs aim to address. If water quality protection efforts that center land protection approaches are to continue building momentum among funders and practitioners, credible practices and credible research that demonstrates the potential of this approach will be crucial. This report, and the accompanying academic literature review, aim to highlight the areas where new standards and targeted research can do the most good in bolstering the present momentum that exists around using land protection to benefit water quality. Complementing novel conservation finance mechanisms with better science for prioritization and evaluation can help culture buy-in from funders, ease the learning curve for new practitioners, and orient scientists towards research with immediate practical applications. Taken together, we hope that these outcomes can help strengthen the understanding of the contribution of land protection to water quality protection

## APPENDIX A: DELAWARE RIVER WATERSHED INITIATIVE LAND PROTECTION FUND

**Interviewee:** Abigail Weinberg, Director of Research, Open Space Institute

“To assess the potential to make an impact we looked at the stressors to water quality, the capacity of organizations to implement the work, and we looked at threats of development.”

—*Abigail Weinberg*

### DRWI at a Glance

**Funding source:** Philanthropic gift

**Service area:** Delaware River basin

**Size:** 12,800 square miles

**Forest cover:** 47% overall, with eight discrete regions ranging from 17% to 84% forest cover

**Water quality goals:** Safeguarding drinking water source for 15 million people in Delaware, New Jersey, New York, and Pennsylvania. More broadly, DRWI partners seek to maintain healthy aquatic ecosystems for diverse benefits to human and ecological communities

**Land conservation goals:** 30,000 acres of protected forests, 40 restoration projects

**Activities funded:** Protection (easement); DRWI also supports restoration activities through separate fund

*Note: DRWI commissioned this review of its own program to facilitate comparison with other water quality protection programs.*

The Delaware River Watershed Initiative (DRWI) is an NGO partnership of more than 50 groups, ranging from The Nature Conservancy, American Rivers, and the Open Space Institute to small regional watershed associations and land trusts. With \$100 million in grants from the William Penn Foundation plus matching funds from many other sources, DRWI aims to safeguard the drinking water supply of the roughly 15 million residents of the Delaware River’s four-state drainage area (OSI 2015) by focusing on the ecosystems that furnish this resource. The partners understand the initiative as seeking to ensure all the benefits associated with healthy watershed, from water quality to quality of life. Established in 2014, DRWI has engaged in an array of research and project implementation activities to advance this mission (OSI n.d.).

The initiative addresses a huge watershed with varied land uses and water quality

stressors (OSI-WPF-ANS 2014). To accommodate this diversity in its conservation strategy, it identified eight “cluster” areas within the Delaware River watershed, each with distinct prevailing conditions (OSI 2015). In the northwestern reaches of the watershed, for example, the Poconos-Kittatinny and Upper Lehigh clusters have more than 70% forest cover, with minimal urban development (11% and 7%, respectively). The Brandywine-Christina, Schuylkill Highlands, and Middle Schuylkill clusters are predominantly agricultural, and the Upstream Suburban Philadelphia cluster is overwhelmingly urban (67% developed area). Primary water quality threats vary by cluster. In five of the eight clusters, forest conversion is recognized as the chief risk to be addressed by conservation actions (OSI 2015).

The initiative pursues both land protection and restoration goals. Partnering with the Open Space Institute, the William Penn Foundation allocated \$17 million to land protection across the

watershed from 2015 to 2018, with the potential to extend funding to a second phase to achieve a land protection goal of 30,000 forestland acres (WPF 2019). The initiative’s land protection program, administered by the Open Space Institute, pursues fee and easement projects that protect sensitive areas in the watershed, including forested headwaters, wetlands, and riparian areas. Complementing these efforts, the initiative also has a restoration program administered by the National Fish and Wildlife Foundation, which supports farmland restoration and storm water management projects in more degraded areas.

DRWI has invested in research and review activities to direct and refine its strategies. The goal-setting process was informed by the Open Standards for the Practice Conservation framework. The framework was designed to help partners narrow their focus and develop local metrics and targets, thus setting initiative-wide quantitative goals from the bottom up, based on targets relevant at the scale of sub-watersheds. DRWI has also relied heavily on the gray literature to inform specific project-selection parameters, and its protocols are vetted by a scientific advisory board consisting of researchers from area universities and institutes. The initiative has also conducted a scientific literature (Morse et al. 2018) review to better understand the links between land uses and water quality.

## **Project Selection**

“Science isn’t the only factor we consider in determining what makes a winning project.”  
—*Abigail Weinberg*

DRWI uses a systematic project selection process with two stages. Proposals from conservation organizations within its eight focus-area clusters are submitted to the Open Space Institute. Seven geospatial and biophysical criteria are then used to assign a water quality protection value to each parcel under consideration (see box).

In addition to landscape factors, DRWI places considerable emphasis on what Abigail Weinberg, Director of Research for the Open Space Institute, characterizes as overall project strength: a combination of partner capacity, financial feasibility, and landowner commitment. A land trust’s ability to execute complex transactions, the strength of its fundraising, and the experience of its staff indicate partner capacity. Considerations like availability of matching funds and project timeline guide evaluation of financial feasibility and landowner commitment.

Weinberg says that the interplay of biophysical project factors and practical considerations is crucial to the final funding decision. A project with a strong biophysical profile may be dropped if practical concerns decrease the likelihood of completion. “If the project isn’t strong from a feasibility perspective,” she notes, “we won’t want to allocate [funding to it] and hold up the money.” The biophysical and practical considerations may be weighted differently in different clusters. A small forested headwaters parcel that would not merit funding on its biophysical merits alone in the relatively intact Poconos region might be a strong candidate in the more developed Schuylkill Highlands, where it would have considerable value as a demonstration of what a clear, clean, high-quality source water landscape looks like.

### **BOX: Project Selection Criteria**

In the first phase of the Delaware River Watershed Initiative, the Open Space Institute evaluated potential land protection projects according to biophysical and geospatial factors determined to be significant for water quality by a review of gray literature, such as the U.S. Forest Service's "Forests to Faucets" report (Barnes et al. 2009). The initiative considers these factors in three stages: at the scale of the watershed (as defined by its hydrologic unit code, HUC) in which the prospective project falls, in terms of the landscape resources on the parcel, and in terms of its vulnerability in a development scenario (OSI 2015).

The initiative weighs the value of protecting small subwatersheds (HUC 12) as follows:

1. Percentage forest or wetland cover, prioritizing watersheds with high (>65%) or very high (>82%) cover.
2. Percentage of riparian area in natural cover, prioritizing watersheds with >70% and ideally >84% riparian natural cover.
3. Erosion potential, prioritizing watersheds with scores in the bottom two quintiles on a 0 to >268 point scale.
4. Rate of groundwater recharge, prioritizing watersheds with >15.7 inches and ideally >17.7 inches of recharge per year.
5. Percentage of headwater streams, prioritizing watersheds with >62% and ideally >76% headwaters streams.
6. Percentage of coldwater streams, prioritizing watersheds with >62% and ideally >85% coldwater streams.
7. Percentage base flow, prioritizing watersheds with > 53% base flow and ideally >60% base flow.

Much of the science has recently been integrated into the planning of local land trusts, to streamline the review of projects by the Open Space Institute.

### **Tracking Success**

"We continue to work toward meaningful goals and measurements. However, the real success of the initiative may be measured by how much local groups adopt science and strategic planning toward a common, initiative-wide goal."

—*Abigail Weinberg*

Recently, DRWI has worked on developing systems to measure the success of protection and restoration efforts, plus outreach and communication. It has a carefully detailed process for evaluating success in biophysical terms and an ongoing monitoring program run by the Academy of Natural Sciences, but its public reporting takes a simpler approach. The Open Space Institute describes the successes of its first phase of funding in terms of project closings, total acres protected, and acres of priority water resources. In its initial three years, internal records show, the land protection fund provided \$8.2 million to 42 projects that protected close to 20,000 acres, comprising 11,000 acres of headwaters, 6,500 acres of stream buffers, and 3,000 acres of

wetlands (OSI n.d.). However, the water quality benefits of this effort are less thoroughly detailed in the initiative's public reporting.

DRWI plans to develop more systematic tools for incorporating monitoring results into its evaluations. It wants to quantify the water quality benefits of land protection and restoration, and also measure the progress of strategies that complement its capital spending on land protection, such as land-use planning, communications work with towns and governments, and dissemination of best practices. "With such a big and diverse initiative made up of so many partners, each step takes time," Weinberg says. "However, the impact reverberates through many organizations."

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