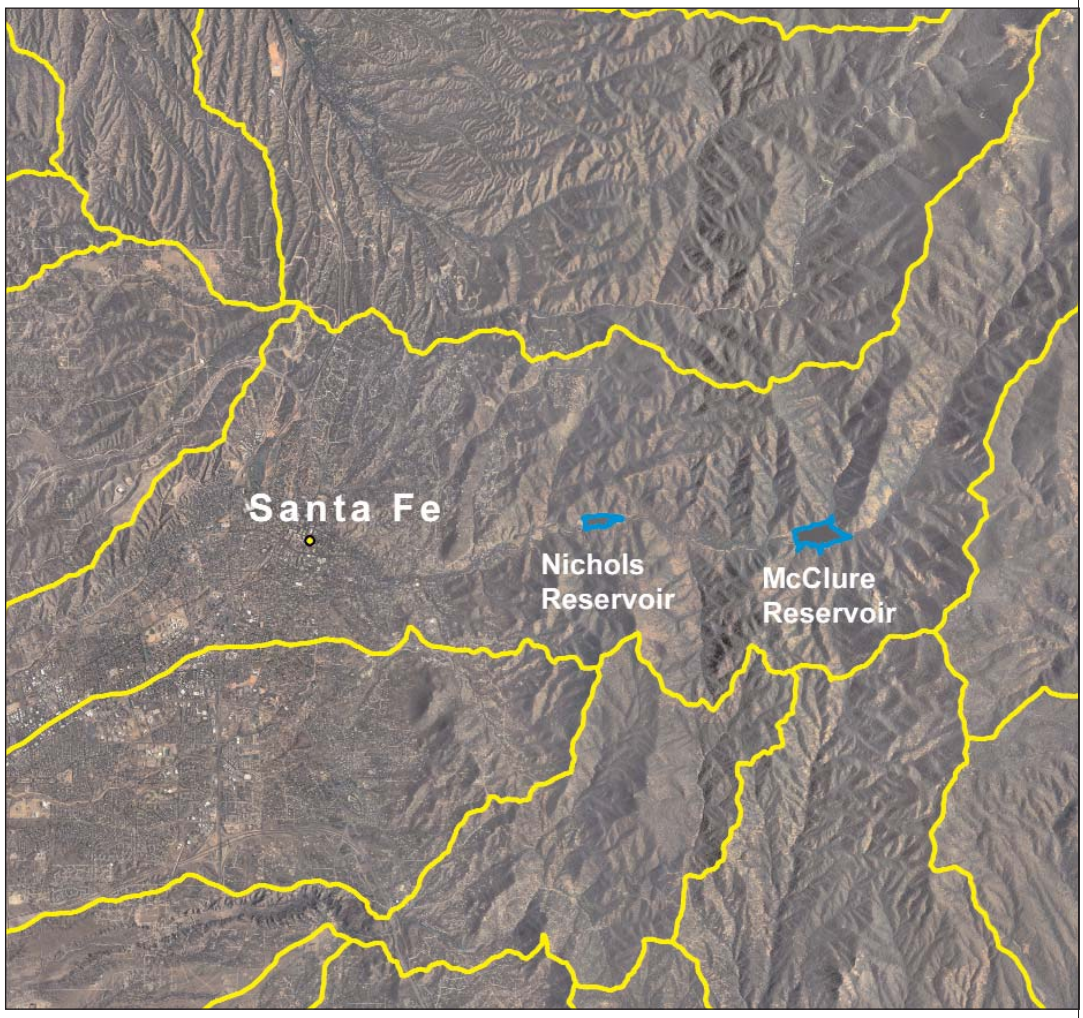
Protecting the City's Water:

DESIGNING A PAYMENT FOR ECOSYSTEM SERVICES (PES) PROGRAM FOR THE SANTA FE MUNICIPAL WATERSHED



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Protecting the City's Water: Designing a Payment for Ecosystem Services (PES) Program for the Santa Fe Municipal Watershed

Executive Summary

Studies of water utilities across the U.S. show that every dollar invested in watershed protection can save tens to hundreds of dollars in costs for new water treatment facilities. Payment for Ecosystem Services (PES) programs provide clear economic incentives for stewardship of watershed land and promote greater awareness about the benefits provided to society by healthy watersheds. By linking the payment of hydrological services to consumers, PES programs also provide sources of funding for conservation, restoration and land acquisition efforts. Research shows that the most effective watershed PES programs are those in which the source watershed is well studied and monitored, and in which a variety of stakeholders are both well informed and involved. Key elements to effective PES program design include defining and estimating an appropriate economic value for the ecosystem services, developing an agreement that guarantees those services to buyers and establishing a payment mechanism.

The greatest threat to the hydrological services provided by the Santa Fe municipal watershed is fire in unmanaged forest. At a cost of $1000 to $2,000 per acre, thinning and burning to restore forest health and natural fire regimes is a cost that land management agencies find difficult to afford. The Santa Fe Watershed Restoration Plan proposes the development of a PES program to pay for the U.S. Forest Service Española District to maintain recently restored forest in the watershed. This plan outlines a comprehensive watershed management program that involves the collaboration of multiple agencies and non-profit groups and emphasizes public outreach and monitoring. In this paper, we discuss guidelines for PES program design, review what has been achieved for the Santa Fe Municipal Watershed and explore case studies in which other U.S. communities have secured their water supply by paying for watershed protection. Based on this analysis, we outline critical next steps for the development of a PES program for the Santa Fe Municipal Watershed. These steps include calculating a value for services provided by the Santa Fe watershed and educating consumers about these services; negotiating a contract for watershed management that maintains the services purchased by water consumers; involving stakeholders in watershed monitoring and establishing a transparent payment mechanism to fund watershed maintenance.

Introduction

Ecosystem services are the conditions and processes through which natural ecosystems supply benefits to people and communities. Typically, these benefits are not included in conventional markets and are thus unpaid for by recipients. Over the last decade, research has demonstrated that healthy forested watersheds provide numerous economically important services to society. Municipalities, water districts, and other agencies are now aligning economic forces with conservation in ways that explicitly link human and environmental wellbeing (Daily and Matson 2008). Payment for Ecosystem Services (PES) programs have gained importance worldwide as a new source of income for land acquisition, restoration and conservation activities. These programs provide clear economic incentives for environmental stewardship by landowners and promote greater awareness among consumers of the valuable services provided by ecosystems. As such, PES programs are one method of achieving watershed protection above and beyond what can be accomplished by regulations alone.

The concept of investing in watershed protection to maintain a water supply is not new. In the 1990's, the city of Seattle realized a plan negotiated in 1896 to acquire all land surrounding the 100,000-acre Cedar River watershed, thereby securing the city's water supply (Ernst 2004). For numerous U.S. cities, investment in watershed protection to safeguard water quality has eliminated the need to construct expensive treatment facilities. By investing $1.5 billion over ten years to protect the Catskill and Delaware watersheds, New York City has avoided spending $6 billion in capital and $300 million in annual operating costs to build new filtration plants (Postel and Thompson 2005, Appendix A).

Surface water for municipal use is an ecosystem service that is neither paid for by the City of Santa Fe, nor by individual water consumers. Water consumers pay the City for the services of capturing, treating, and delivering water, but not for producing the water. The Santa Fe Municipal Watershed Restoration Project proposes to implement a PES program that (i) provides a sustainable stream of local funding to maintain the Santa Fe watershed, (ii) educates the public about watershed management and the value of services supplied by a healthy watershed, and (iii) encourages water conservation by consumers. The Santa Fe Watershed case is unique in that the City is not yet facing pressures to build more treatment facilities, rather PES is sought to fund the maintenance of forest restoration activities as an insurance policy against future threats to the municipal water supply.

The purpose of this paper is to present guidelines for developing a PES system for the Santa Fe Municipal Watershed. We briefly outline the services derived from healthy watersheds and the threats to the Santa Fe watershed. We discuss guidelines for PES design as they apply to the Santa Fe watershed and cite case studies in which other U.S. communities have secured their water supply by paying to protect the source watershed. These case studies demonstrate the approaches used by public utilities and communities to gain long term local financing of watershed protection. We conclude by summarizing critical next steps that may guide the development of a PES program for the Santa Fe Municipal Watershed.

a. Threats to Services Provided by the Santa Fe Municipal Watershed

The goods and services provided by healthy forested watersheds are of critical importance to all New Mexicans (Table 1). Among them, flow regulation, flood control and protection against runoff, erosion and sedimentation rank high in importance in Northern New Mexico, where much of growing season precipitation comes in spurts of heavy rainfall during the summer monsoons.

Table 1. Ecosystem goods and services provided by healthy watersheds (adapted from Postel and Barton, 2005).

- Water supplies for urban-domestic, agricultural and industrial uses
- Water filtration/purification
- Flow regulation
- Flood control
- Erosion and sedimentation control
- Groundwater recharge
- Fisheries
- Recreation
- Habitat and biodiversity preservation
- Microclimate stabilization
- Carbon sequestration

Unlike many municipal watersheds, the upper Santa Fe River is not threatened by encroaching development, agriculture or industrial pollution. The two reservoirs that supply 40 percent of the City's water are surrounded by Ponderosa pine and piñon-juniper stands that cover the lower canyon's steep walls on U.S. Forest Service land. The upper watershed, comprising 10,000 acres in the Pecos National Wilderness, is primarily mixed conifer forest that typically experience infrequent but catastrophic stand replacing fires. To date, nearly 6,000 acres of Ponderosa pine in the lower watershed have undergone thinning and some controlled burning to reduce fuel loads, however the upper watershed remains untreated. The combined cost of thinning small diameter trees and burning to reintroduce natural fire regimes ranges from $1,000 to $2,000 per acre. Because of limited markets and the low value of the material thinned from these forests, restoration activities can be prohibitively expensive for land management agencies and private landowners.[1,2] Therefore, the greatest risk to the Santa Fe watershed is uncontrolled fire in the untreated mixed conifer stands, as well as management practices that fail to maintain recent forest restoration treatments in the lower basin, a scenario seen throughout New Mexico.

One hundred years of fire suppression have rendered Southwestern forests overcrowded, vulnerable to pests and highly prone to stand replacement fires that strip steep slopes of soil protecting vegetation. The loss of forest cover decreases a watershed's capacity to regulate flow and control soil erosion. Research of the Los Alamos reservoir following the 48,000-acre Cerro Grande fire

[1]Ron Ortega, Forester, New Mexico Forest and Watershed Institute, personal communication on August 25, 2008.
[2]Naomi Engleman, Director, New Mexico Forest Industry Association, personal communication on August 26, 2008.

(in which one third of the basin's mixed conifer forest were severely burned) measured a dramatic spike in the sedimentation rate. One year after the fire, reservoir sedimentation was 140 times higher than the previous 57 years, and remained significantly elevated throughout the five-year study period (Lavine et al. 2005). Reservoir sedimentation caused by soil erosion reduces the quantity and longevity of water supplies and substantially increases filtration costs. A 2002 study of 27 water suppliers across the U.S. demonstrated that water treatment costs increased significantly with progressive loss of forest cover (Ernst 2004).

b. Enhanced Water Conditions through Vegetation Management

It can be difficult to demonstrate the relationship between forest management activities and ecosystem services because the results are not constant from year to year (Tognetti 2001). However, forest restoration treatments such as thinning and prescribed burning reduce tree density, encourage the growth of large healthy trees and understory grasses, and decrease the risk of disease and fire. Moreover, by decreasing transpirational water loss from trees, forest thinning can be an important tool to increase hydrological flow. In particular, removal of water-guzzling exotic invasive species, such as Salt cedar (Tamarix spp.), from riparian Bosque forests can increase stream flow, and a similar effect has been demonstrated in other forest types. A paired basin study of the Santa Fe Watershed demonstrated that mean daily flow in the Santa Fe River increased by 50% two years following thinning, compared to the previous four years of pretreatment measurements (Watershed West 2008). Research at Valles Caldera National Preserve also shows that thinning high density forests can increase annual spring runoff and river flow by reducing sublimation losses of winter snow pack (Valles Caldera Trust 2007). However, increased flow following restoration treatment may be most important in higher altitude forests and may decrease over time (MacDonald and Stednick 2003).

Vegetation management is critical to restoring forests, reducing the risk of fire and maintaining water quality throughout the western U.S. Following massive soil erosion caused by the Hayman (2002) and Buffalo Creek (1996) fires in Colorado, Denver Water was forced to undertake a costly program to remove sediment from mountain reservoirs and unclog pipes. Projected to cost $31 million, the Colorado utility estimates it has already spent more money clearing sediment that flowed into reservoirs after fires than would have been required to treat the areas before the fires. Concerned that another major wildfire could erupt in stands of dry, beetle-killed trees, Denver Water has approached legislators with the idea of imposing a "watershed maintenance fee" to help clean up forests to reduce the risk of future fires. The fees would help offset the cost to remove beetle-killed trees, create fire breaks and thin 20 to 30 percent of forest identified as critical to watershed health (Denver Post 2008).

Guidelines for Developing Watershed PES Programs

Numerous publications by non-profit groups, such as the Trust for Public Lands, Forest Trends and the Katoomba Group, offer guidelines for developing watershed PES systems. According to Ernst (2004), "best practices" for any watershed plan include (a) understanding the watershed

and prioritizing protection, (b) focusing on partnerships with watershed stakeholders, (c) developing a comprehensive water protection plan, (d) developing a "funding quilt". In addition, the development of a watershed PES program requires that the ecosystem service provided be well defined, valued economically and easily measured and monitored. Finally, a payment mechanism that fits existing institutional conditions must be set up (Johnson et al. 2000). We use these guidelines as a framework for assessing what has been accomplished to date for the Santa Fe watershed and attempt to identify what remains to be done to develop at PES program.

a. Understand the watershed

Prior to undertaking restoration treatments in the Santa Fe Watershed, the Española District of the Santa Fe National Forest prepared an Environmental Impact Statement (EIS), in which the potential impact of the prescribed thinning and burning on ecosystem function was assessed, based upon data collected by Forest Service personnel and studies of similar ecosystems in the region (USDA Forest Service 2001). Priorities for Santa Fe watershed protection were determined in a Forest Management Plan that divides the watershed into two planning zones upstream from the City water supply reservoirs (the upper Pecos Wilderness and Forest Service land). Despite the information contained in the EIS, much remains to be learned about the impact of forest restoration treatments on hydrological flow, water quality, aquatic wildlife and fire prevention in this region. Ernst (2004) recommends using maps and models to prioritize watershed management, which are not only useful planning tools, but also offer an effective means of communicating to the public the attributes of a watershed, including threats to watershed health.

Comprehensive water quality monitoring is another key to understanding watershed health and tracking the impact of land use change on water quality (Ernst 2004). Monitoring is an essential tool for adaptive management in areas where land managers are experimenting with innovative practices. The Santa Fe Municipal Watershed Protection Plan states that funds from a PES program will be used to conduct long term monitoring of forest health, building upon a program already in place. Continued monitoring of river flow and water quality (sediment and nutrient loads) will be necessary to demonstrate to Santa Fe water consumers that they are receiving the services that they are paying for under a PES program.

Results from monitoring studies can be made available to the public online through a data sharing project conducted by River Source (www.watershedwiser.org), an organization that involves communities, schools and Native American tribes in local watershed monitoring, education and restoration activities. Involving the public in watershed monitoring serves several purposes, including (i) educating consumers about the value of watershed ecosystem services, (ii) engaging citizens as stakeholders in the watershed management process, and (iii) encouraging greater awareness and stewardship of water resources.

b. Focus on partnerships and stakeholder participation

The city of Salem, Oregon has learned the importance of partnering with federal and state land

management agencies to achieve long term water goals. Eighty percent of land in the city's primary watershed is owned by the US Forest Service (USFS), the Bureau of Land Management (BLM), and the Oregon Department of Forestry (ODF). After declaring a water emergency following the 1996 North Santiam River flood, the city of Salem was forced to install a $1 million pretreatment facility to lower turbidity levels that overwhelmed their sand filtration system. According to a US General Accounting Office report, timber harvesting and related road construction contributed heavily to soil erosion during the 1996 flood (Hill 1998). Since then, the city has worked closely with the USFS, BLM and ODF to implement improved watershed management practices. A Memorandum of Understanding (MOU), signed by all agencies, described the city's watershed protection goals and the city now participates in site assessments for all timber sales. In addition, an online water quality monitoring program was created that is cost-shared with the USGS (www.Oregon.usgs.gov/pubs_dir/WRIR03-4098/) (Ernst, 2004).

The Santa Fe Municipal Watershed Restoration Plan outlines key agency and nongovernmental partnerships already in place, with partners collaborating on different components of a comprehensive plan. Those partners include the USFS Española District (the water supplier), the City of Santa Fe Water Division (the link between the water supplier and water consumers), the Nature Conservancy (involved in writing a financial plan) and the Santa Fe Watershed Association (SFWA -conducting public outreach). A public education campaign by the SFWA is the next critical step to promoting stakeholder understanding of the value of watershed health and acceptance for a PES program. The outreach plan proposed by SFWA includes (i) tours of the municipal watershed, (ii) local media communications and special events, and (iii) an elementary school education program. Outreach must also be targeted directly at Santa Fe water consumers to convince them that paying for watershed protection is in their best interest.

Public education and grassroots efforts to mobilize voters proved crucial to the success of the San Antonio Water System (SAWS) Land Acquisition Program (LAP). In 2000, voters in San Antonio, Texas, approved a bond measure that increased the sales tax by one-eighth cent to fund greenways around the city's sensitive creeks and land acquisition to protect the Edwards Aquifer. Of four bond issues on the 2000 ballot (including measures to increase tourism and attract new businesses) only the water quality measure was approved. The measure raised $65 million over 4 years and has preserved 10,000 acres of geologically sensitive land since 2000. The LAP funding is allocated through a portion of the Water Supply Fee (Ernst 2004).

Critical to the maintenance of public confidence in its water supply and water supplier is transparency. For this reason, most publications recommend that proposed PES fees be made explicit to the public, following an aggressive outreach campaign. This underscores the importance of demonstrating to stakeholders that the benefits of the program are (or will be) greater than or equal to the costs of implementation. To quantify these benefits, agencies often point to the avoided costs associated with protecting watersheds.

c. Value the ecosystem services

A public outreach campaign should educate water consumers about the threats to Santa Fe's water supply, and demonstrate that proactive watershed protection measures cost significantly less than building infrastructure to address water issues resulting from watershed degradation. This comparison necessitates estimating a monetary value for the ecosystem services supplied by restored USFS lands and projecting the cost of replacing this service in the future. There are several formal economic valuation techniques that can be used to accomplish this, including: hedonic analysis, replacement cost, avoided cost, travel cost, contingent valuation, and benefits transfer. The valuation techniques most relevant to the Santa Fe situation are contingent valuation, benefits transfer, and replacement and avoided costs. These techniques are needed because ecological services are typically provided at little or no cost the public even though ecosystem degradation does imply costs for restoring what was lost. As a result there are no "prices" to be used to estimate value because these services cannot be purchased in a market. For this research the estimation techniques are often referred to as non-market valuation techniques.

Contingent valuation is a commonly used method of estimating the values of non-market ecosystem services. In a contingent valuation study, researchers collect information via questionnaires on the amount respondents are willing to pay to protect a given resource, or the amount they would be willing to accept to allow degradation of a given resource. A limitation to contingent valuation studies is that they report people's willingness to pay based on stated preferences to hypothetical scenarios, which may be in contrast to the actual actions taken by respondents.

The benefit-transfer method calculates the values of ecosystem services at a site based on the results from hedonic, contingent valuation, travel cost, or other studies conducted elsewhere. For example, the value of watershed enhancement in Santa Fe might be calculated based on studies conducted on watershed enhancement in Denver, Colorado. A benefit transfer study may save time and money, but the analysis is less applicable if significant differences exist between the study site and the site in question.

Another valuation technique employs avoided costs or replacement costs. These costs are associated with replacing ecosystem services provided previously by riparian areas, or avoided as a result of enhancing natural areas. A striking example of avoided costs related to natural resource enhancement is the Charles River Natural Valley Storage Project.

The Charles River Natural Valley Storage Project is a US Army Corps of Engineers (Corps) project that helps control flooding in Boston, Massachusetts by preserving nearly 7,000 acres in 17 existing wetlands. The Corps spent $10 million in land and preservation easement purchases to accomplish their storage goal. This is ten percent of the $100 million that it would have cost to build a dam with similar storage capacity. The City of Boston also saves an estimated $17 million annually in flood damage because of the project. In addition, an estimated 1.5 percent premium has been added to the values of homes in the area due to flood-protection and amenity values provided by the wetlands (Morrison 2005). Other examples of avoided costs associated with watershed protection can be found in Appendix A.

As in any market, the price for an ecosystem service is ultimately determined by what the buyer is willing to pay and what the seller is willing to accept and deliver. From a sellers' (USFS Española District) perspective, the main considerations in negotiating a PES will be (a) costs for complying with the agreed upon land management practices over time (b) impact on the USFS revenue in terms of changing land management practices (if any) and (c) administration costs under the expected PES transaction over time (Forest Trends 2008).

d. Develop a watershed protection plan

Development of a Santa Fe watershed protection plan is already well underway under the direction of the USFS Española District. Financing the maintenance of restoration treatments undertaken to protect the watershed is the next critical step for the City of Santa Fe Water District. It is recommended that multiple funding sources (or a "funding quilt" – discussed below) finance the cost of watershed protection.

A key to a successful PES program is simplicity in all aspects of the program (design, implementation, and monitoring). A survey of 61 watershed based payment schemes found that watershed markets are more institutionalized than other ecosystem services, and rely on cooperative relationships between demand and supply (Landell-Mills and Porras 2002). The Santa Fe Municipal watershed situation is very conducive to a simple PES program, with one supplier of water (USFS Española District) linked to consumers through the City of Santa Fe Water Division. A well-developed forest management plan will help the Forest Service and the City estimate the future costs to consumers to maintain the upper Santa Fe watershed. These watershed maintenance costs can serve as the basis for estimating the value of the ecosystem services "sold" under the City PES scheme.

e. Establish a payment mechanism

There are three general financial incentive mechanisms to describe the PES in practice today. These include self-organized private deals, trading schemes, and public payment schemes (Johnson, 2000). The most relevant incentive mechanism to the City of Santa Fe is the public payment scheme. Of the three categories, this is the most predominant in the world today. Financing can come from a variety of sources including general tax revenues, bond issues, or user fees. Generally, negotiations between downstream and upstream governments, businesses, and citizens groups establish the incentives and mechanisms for the PES. Due to the public nature of hydrological services, publicly financed payments for ecosystem services are likely to remain the most common financial mechanism used to protect water related ecosystem services (Johnson et al. 2000).

The Katoomba Group (2008) outlines several key elements to consider when developing a PES contract:

- Terms and type of payment, specifying when, how much, how often and to whom
- Timing of payments when ecosystem service activities are carried out by a seller

- Payment requirements, such as monitoring, reporting, and verification
- Risk management through a clause detailing how risks are shared
- Contract signatories affiliated with the buyer and seller

f. Develop of a "funding quilt"

An example of a "funding quilt" with multiple sources is the Hawkwatch project in Rockaway Township, New Jersey. The funding for this project reached over $7 million to protect local water resources. Local property taxes in Morris County and Rockaway Township contributed $1.5 million. This was supplemented by $3 million from the state's Green Acres program with a mix of grants and loans. Private foundations contributed an additional $1 million. The federal Forest Legacy program and the state grant portion of the federal Land and Water Conservation Fund contributed another $2 million.

It is recommended that the City of Santa Fe begin developing a funding quilt through the options available to them. One possible source is through the US Environmental Protection Agency (EPA). The EPA provides annual grants to states under a Clean Water State Revolving Fund. The money is generally used to provide loans for wastewater treatment plants, but several states have used the money to help local governments and nonprofits purchase watershed land, restore watersheds, and reduce flooding (Ernst, 2004). Other potential financing sources include loans, private contributions, taxes, and other grants.

Conclusions: Where to Go Next?

Studies of water utilities across the U.S. show that every $1 invested in watershed protection can save anywhere from $7.50 to nearly $200 in costs for new filtration and water treatment facilities (Johnson et al. 2000). Our review of literature and of the Santa Fe Municipal Watershed Restoration plan suggests that the City of Santa Fe Division of Water is in an excellent position to develop and implement a PES program that creates a fund to pay for future watershed maintenance and restoration treatments.

According to the Santa Fe Municipal Watershed Restoration Plan, many of the criteria and practices suggested by most PES guides have already been met. The threat posed by fire to ecosystem services provided by the Santa Fe watershed is well understood by resource managers and easily explained to the public. City, Federal and Nonprofit organizations are already collaborating to develop a comprehensive watershed management plan that recognizes the importance of public outreach and stakeholder involvement. A monitoring program exists that can be expanded to inform adaptive management strategies, involve the public as stakeholders and reassure water consumers that they are receiving the ecosystem services for which they are paying under a PES program. And finally, the Santa Fe situation lends itself well to a simple public payment scheme in which the cost for watershed maintenance provided by the USFS Española District can be offset by a user fee paid by water consumers to the City of Santa Fe. Below we recommend some critical next steps that will help facilitate the design and implementation of a PES program for the Santa Fe Municipal watershed.

- Calculate the value of water provided to Santa Fe consumers and the cost to the USFS Española District for future watershed maintenance, including transaction costs.

- Negotiate a contract with the USFS Española District for long-term enhanced management of sensitive areas.

- Conduct a far-reaching outreach program to educate stakeholders about both the economic benefits and costs of the proposed watershed management plan.

- Build an extensive watershed-monitoring program that involves citizens' groups and make the results available to the public.

- Evaluate monitoring results frequently and use them as part of an adaptive management strategy

- Establish the preferred funding PES mechanism (tax, bond, user fee), considering legal and political implications of each. Choose a mechanism that fits within existing institutional conditions and seek additional sources of funding.

- Maintain public trust by making all PES transactions transparent and explicit

- Share PES program experiences early and often, especially with decision-makers and stakeholders.

- Consult guides, such as PES Getting Started Primer (Katoomba Group 2008) for details about drawing up contracts, valuing resources and selecting payment schemes. This and other resources are available for download online at: http://www.ecosystemmarketplace.com/

- There is no blueprint that fits all situations. The mechanism that will work best for Santa Fe will be the result of what the USFS Española District is able to do to maintain the watershed, and what the City is willing to pay to maintain the ecosystem services provided by the watershed.

Acknowledgements

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Appendix A – Other Relevant Examples

By protecting 434 acres of land around Lake Auburn, the city of Auburn, Maine was able to avoid building a new water filtration plant, saving $30 million in capital costs, and an additional $750,000 in annual operating costs. To achieve this, the Auburn Water Department spent $570,000 to acquire land in their watershed, the funding for which came from a Drinking Water State Revolving Fund Loan (Ernst 2004).

Nashua River Watershed extends through 31 communities in northeastern Massachusetts. The Nashua River Watershed Association (NRWA) has been working since 1969 to protect and preserve the ecosystem of the Nashua River. In 2001 NRWA participated in a demonstration project by the EPA and identified critical areas in the watershed. Since then the NRWA has contacted private landowners in these critical areas to discuss options for participation in state forest stewardship programs, which offer tax breaks for implementing forest management plans, and ways that landowners can conserve their property through state and federal easement and cost share programs (Ernst 2004).

Maryland's Tributary Strategies showed that to reach a forty percent reduction in nutrient loads, forest buffers and non-structural controls were significantly more cost effective than engineered approaches. Forest buffers are estimated to cost $671,000 and non-structural shore erosion prevention/control $1.6 million per year. Comparable structural techniques could cost $3.7 million to $4.3 million per year (Palone 1998).

The water utility in Fairfax County, Virginia estimated savings of approximately $57 million in storm water costs by maintaining forest areas and riparian buffers (Palone 1998).

The New York City Program is the largest scheme in the world that puts into effect direct payments by water consumers to providers of watershed services. To ensure a pure and safe water supply, New York City negotiated partnerships with upstream landowners and over 70 communities within the city's municipal watershed. In 1997, the city signed a memorandum of agreement (MOA) that committed the city to spend $1.5 billion over 10 years to restore and protect the Catskill and Delaware watersheds and invest in measures that improve the local economies of watershed communities. A program to improve forest management, initiated in partnership with watershed landowners, loggers and timber companies, was among many innovative measures taken by the city. By taking this course of action, the city avoided spending $6 billion in capital and $300 million in annual operating costs to build new filtration plants in order to comply with the Safe Drinking Water Act. Financing for this program comes from additional taxes on residents' water bills and from bonds issued by the city (Postel and Thompson 2005).

Appendix B – Contact Information for Case Studies Cited in Text

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New Mexico Forest and Watershed Restoration Institute

The New Mexico Forest and Watershed Restoration Institute at New Mexico Highlands University is dedicated to providing state-of-the-art information about forest and watershed restoration to the public, federal and state agencies, tribes, and private landowners in New Mexico. To accomplish this, the Institute collaborates with citizen stakeholders, academic institutions, NGOs, and professional natural resources managers to establish a consensus concerning prescriptions and monitoring protocols for use in the restoration of forests and watersheds in an ecologically, socially, and economically sound manner. Through research and collaboration, the Institute promotes ecological restoration and forest management efforts in ways that 1) will keep New Mexican homes and property safe from wildfire, 2) will lead to a more efficient recharge of New Mexican watersheds, and 3) will provide local communities with employment and educational opportunities.