Changing Landscapes

Land use planning curriculum for natural resource professionals

P rinciples, people, and policies
L and planning and pressures
A pproaches
N atural resource planning tools

P5: Principles of Ecosystem Services

Timber harvesting is one of the few ecosystem services that has fully functional markets and prices.
(Photo: http://www.nhstateparks.org/)

Overview

This factsheet provides a basic overview of ecosystem processes, services, and products provided by both rural and urban forests. It discusses how difficulties in estimating the monetary value of carbon sequestration and other ecosystem services impede establishing economic markets and prices. Compensating landowners and others for conserving ecosystem services provides an incentive for landowners that can contribute to better natural resource protection and management.

Environmental Value of Trees and Forests

Trees and other living parts of a forest, such as soils, microorganisms, and wildlife, support healthy forest ecosystems, which provide many benefits now called ecosystem services. These include an array of environmental, economic, health, social, and other benefits. The following illustrate some of the most important ecosystem services typically provided by forests.

Timber and other forest products

Timber harvests are among the few ecosystem services for which there are fully functional markets and prices. In 2011, U.S. Forest Service lands alone yielded about $150 million of timber. This figure does not include the value added as products are manufactured and sold from timber.

Tourism

National parks and Federal lands generate jobs and tourist dollars. Nationwide in 2010, national parks provided some 267,000 private-sector jobs and generated $13.3 billion in economic activity in nearby communities.

Tourism generates both jobs and tourist dollars.

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Northeastern Area State and Private Forestry
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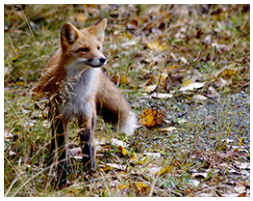
Trees, other plants, and soil help protect water quality.

Clean water

The ability of trees, other plants, and soil to protect water quality was a crucial element in the earliest movements to preserve large areas of forest. In 1855, Philadelphia set aside 7,000 acres of forested land and created Fairmount Park to protect the city's water supply. In 1885, the Adirondack and Catskill Reserves in Upstate New York were established to protect water for New York City residents, far downstream. Water protection and regulation were fundamental reasons for passage of the U.S. Forest Reserve Act of 1891, the precursor to our National Forest System. In fact, two-thirds of the Nation's freshwater supply originates in stream water that is filtered through forests.



Wildlife provides value through many different ecosystem services.

Wildlife

Wildlife provides value through many different ecosystem services including biodiversity, hunting, tourism, observations, or simply our knowledge of their existence. In 2006, the National Wildlife System generated almost $1.7 billion in economic activity for local communities. That same year, hunters, fishers, and wildlife watchers in the United States spent $122.3 billion on those activities. Wildlife also provides critical components of other ecosystem processes such as pollination and seed dispersion.

Maintaining existing forests is considered one of the least expensive options for mitigating climate change.

Carbon sequestration

Because atmospheric carbon is a primary component in climate change and risk, much attention is being placed on forests as a way to reduce the negative consequences of climate change by sequestering (storing) carbon. In general, rural forests sequester from 11 to 21 tons of carbon an acre. Sequestration can range from 35 pounds per year for small, slow-growing trees to 800 pounds per year for larger trees growing at their most vigorous rate.

The Difficulties of Carbon Markets and Prices

Markets for carbon credits and carbon trading programs are being developed for national and international efforts to reduce greenhouse gas emissions. The development of carbon markets has been hampered in the United States by the fluctuation of the price per ton of carbon. For instance, a 1996 inventory of Philadelphia trees calculated a carbon storage of 530,000 tons with an estimated value of $9.8 million, which represents a trading value of $14.49/ton of carbon among 2,113,000 trees. But the 2008 inventory of street trees in Pittsburgh reflected a market trading value of $6.68/ton of carbon, considerably lower than the 1996 price in Philadelphia.

Recently in California, the State Air Resource Board was charged with administering Assembly Bill 32, California Global Warming Solutions Act of 2006. The mission of this act is no net loss of forest carbon. Several problems continue to slow their development of a carbon trading market, including the difficulty of monitoring forest carbon via remote sensing and estimating soil carbon. Conflict has been caused by the treatment of timber harvest as a carbon emission rather than considering the benefits of long-term storage in wood products. The long timeframes involved in carbon contracts (for example, 100 years), which some feel ignore the wholesale loss of standing forest carbon due to insects, disease, and fire, is also problematic. Some also question who actually profits from any carbon trading market—the landowner, or the broker trading the credits?

Society of American Foresters. 2011. Special issue: Managing forests because carbon matters: integrating energy, products, and land management policy. Journal of Forestry Supplement. 109(7S): 48 p.

Canada's 1.3 billion-acre boreal forest is estimated to store 67 billion tons of carbon with an estimated value of around $3.1 trillion. Maintaining existing forests, nationally and internationally, is considered one of the least expensive options for mitigating climate change. Although faced with some difficulties, efforts are underway in California and other States to reduce overall industrial carbon emissions by developing effective carbon markets and prices.

Threats to Ecosystem Services

Broadly speaking, natural processes that sustain human life provide ecosystem services. Prices and markets are used to quantify the value of these services. Some services, such as timber and tourism, are readily marketed and priced. It is harder to determine the monetary value of other services, such as cultural values or values to future generations.

> Natural processes that sustain human life provide ecosystem services.

Given the difficulties in valuation, the true short- and long-term costs and benefits of ecosystem services are not always adequately considered in net present value and other economic modeling. Ignorance and undervaluation of ecosystem services can cause natural resources to be overlooked or poorly considered in land development and other economic decisionmaking. Often the values of ecosystem services are only recognized when society has to pay to manage or repair them following such events as wildfire, flooding, stormwater damage, and erosion.

In addition to being inadequately valued in economic decisionmaking, ecosystem processes and services face other threats. Misunderstanding of ecosystem services by both citizens and elected officials impedes their consideration in land use planning and regulatory policy. Many times parks and other natural landscapes are viewed as only aesthetic resources, and the full value of economic, human health, and other services are not considered. The lack of planning at a multimunicipal or larger scale interferes with the conservation of healthy natural systems and high-quality human recreation.

Deforestation, degradation, and conversion of forests and other natural landscapes by suburban and rural development are other serious threats. By one estimate, 1.5 million acres of private forest land in the United States are lost to subdivision and other conversion each year.

Threats to Ecosystem Processes and Services

The many threats to forests and the ecosystem services they support are complex and interconnected. Here are some of the most pressing ones:

- Climate change, which is expected to produce warmer air temperatures, altered precipitation patterns, drought, and more extreme weather events.
- Air pollution, including regional deposition of heavy metals, ozone, nitrogen, sulfur, and hydrogen.
- Difficulties in placing values on ecosystem services and in developing economic markets for better understood services such as carbon sequestration.
- Increased public demand to live and recreate in forests, increasing their value and making them more attractive for conversion into residential development.
- Changing social and demographic values, such as an aging population of landowners, leading to an increase in forest sale and conversion.
- Lack of understanding among leaders and the general public about the value of nature to people and the places they live.
- Small planning scales and lack of multimunicipal or landowner cooperation.
- Inadequate consideration of natural resources in comprehensive plans, zoning, and capital budgeting.
- Invasive insects such as pine beetle and emerald ash borer, and invasive plants such as kudzu and European buckthorn.

Conversion of forests to other uses, especially to intense uses with impervious surfaces, can have detrimental effects on water supplies and carbon sequestration. Emissions from agricultural and other land conversion worldwide are estimated to account for one-fifth of current global carbon emissions. In addition, conversion and parcelization of forest often have a negative impact on wildlife, timber harvesting, and tourism. Conversion and parcelization can also increase the risk to life and property by wildfire and other natural forces.

Conversion of forest land to housing developments threatens the services that ecosystems provide. (Photo: ©Google)

Protecting Ecosystem Services

Having a diversity of markets for forest products and other ecosystem services may create an economic environment where owning and managing forest land for multiple benefits is more desirable than subdividing, selling, or converting the forested property. Developing carbon and other ecosystem service markets (for example, water quality trading) or paying landowners directly for conservation (for example, U.S. Conservation Reserve Program) can provide incentives for better natural resource protection and management by compensating landowners for their conservation efforts. There are a number of common payment approaches for conserving ecosystem services:

- **Voluntary transactions**, including the sale of carbon credits, conservation easements, and land for conservation to government and conservancies.
- **Public payments**, including payments from government agencies to landowners for afforestation, reforestation, or forest management projects.
- **Compliance-driven transactions**, including water quality trading, wetland or stream mitigation, and other mechanisms developed in response to government regulation.

Strategies to Protect Ecosystem Services

- Develop partnerships between landowners; businesses; and local, State, and Federal governments to understand and develop potential economic opportunities and markets for ecosystem services provided by private property.
- Educate leaders and citizens on the full scope of direct and indirect ecosystem services, such as human health and economic benefits, not just environmental and recreational ones.
- Always consider the natural environment in land use planning and regulatory policy.
- Work to establish multimunicipal, regional, and other larger planning areas.
- Increase early detection and management of ecosystem threats such as invasive species and excessive stormwater.

Other tools related to land use planning and regulatory policy include:

- **Tax policies**, such as appraising the worth of forest property based on how it is currently being used, not on its development potential or market value.
- **Nonregulatory strategies**, such as density bonus and other developer incentives.
- **Purely regulatory approaches**, such as zoning, subdivision, and land development ordinances.

Creating Ecosystem Markets

- ForCES: Expanding Forest Stewardship Council (FSC) Certification to Ecosystem Services. Forest Stewardship Council. http://forces.fsc.org/. (19 April 2013).
- Kline, Jeff; Patterson, Trista. 2012. Ecosystem service markets 101: supply and demand for nature. Issue 144, Science Findings. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p. http://www.fs.fed.us/pnw/sciencef/scifi144.pdf. (19 April 2013).
- Willamette Partnership; Pinchot Institute for Conservation; World Resources Institute. [n.d.] In It Together: A How-To Reference for Building Point-Nonpoint Water Quality Trading Programs. Three parts. http://willamettepartnership.org/publications/ (23 October 2014).

Wetland on Mount Desert Island, Maine.

Paying Landowners for Stewardship of Ecosystem Services

Higher property values in many rural areas, coupled with aging landowners, are creating pressures to subdivide and develop private working forests. Creating markets for ecosystem services, providing financial incentives, and changing land-use and tax policy could help generate the revenue streams needed to raise the value of working forest lands so they can better compete with sales for residential development. Payments for carbon sequestration, watershed management, ecotourism, and a host of other services may supplement timber and other traditional forest revenues and promote long-term forest stewardship. There are a number of common payment approaches used in land-use policy design to conserve ecosystem services. These include:

1. Voluntary transactions such as the sale of conservation easements.
2. Public payments, including payments from government agencies to landowners for reforestation projects.
3. Compliance-driven transactions such as wetland or stream mitigation in response to government regulation.

Mercer, E.; Cooley, D.; Hamilton, K. 2011. Taking stock: payments for forest ecosystem services in the United States. Forest Trends. Washington, DC. 49 p. http://www.forest-trends.org. (18 April 2013).

Society of American Foresters. 2011. Special issue: Managing forests because carbon matters: integrating energy, products, and land management policy. Journal of Forestry Supplement. 109(7S): 48 p.

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The Economic Value of Open Space Protection

A 2010 study of the economic value of open space in southeastern Pennsylvania by the Delaware Valley Planning Commission and the Green Space Alliance identified substantial benefits, including:

- $61 million in annual water quality services (for example, filtering).
- $16.3 billion added to the value of housing stock, generating $240 million annually in property tax revenues.
- $17 million annually in air pollution removal and carbon sequestration.
- $1.3 billion in health-related savings resulting from physical activity.

Delaware Valley Regional Planning Commission. 2011. The economic value of protected open space in southeastern Pennsylvania. Pub. No. 11033A. Philadelphia, PA. 78 p.

Ecosystem Services and Green Infrastructure

Although forests and other large-scale landscapes are crucial in providing ecosystem services, the green infrastructure of parks, street trees, and other public landscapes in our cities and towns is also extremely important. Close to 80 percent of the United States population lives in urban areas, and the ecosystem services provided by the urban forest touch most citizens and visitors daily. There are an estimated 3.8 billion urban trees in the United States with an estimated structural value of $2.4 trillion. This estimate considers only the replacement of these trees and actually *under*estimates their value in terms of economic, environmental, human health, and other ecosystem services.

Urban trees and parks provide many ecosystem services.

Close to 80 percent of the United States population lives in urban areas. The ecosystem services provided by the urban forest touch most citizens and visitors daily.

The natural resources in our municipalities are highly diverse, ranging from healthy natural areas within urban wilderness preserves to open space and greenways, to traditional parks, to woodlots, and even to trees and plants found in streetscapes and other residential and business landscapes. Although it is obvious that larger scale systems such as regional parks and open space systems provide water, air, recreation, and other services, the many smaller structural components, including the canopy and roots of individual street trees, together contribute substantial energy and water and air quality services. The value of this bundle of services is a main reason why the conservation and management of trees and open space should be adequately considered in municipal land use planning and regulatory policy and budgets.

The many benefits provided by green infrastructure fall into several categories—environmental, health, economic, and societal.

Environmental Benefits

Among the many ecosystem services provided by urban trees and parks, those that have been particularly well studied and valued include energy and climate moderation, stormwater mitigation, and air quality.

Energy and Climate Moderation

Trees and parks moderate climate and help keep people and places comfortable, which in turn conserves energy and lowers energy costs. Trees and green areas cool the "heat island effect" that characterizes most urban areas. Temperatures under shade trees can be 9 degrees cooler than in sunny surroundings. Shading parking lots can reduce car interior heat gains dramatically—by as much as 47 degrees! If planted correctly on the east and west sides of a home, two large shade trees can save up to 30 percent on air-conditioning costs. Trees placed properly around buildings as windbreaks can save up to 25 percent on winter heating costs. According to some estimates, the proper establishment of 100 million mature trees around residences in the United States would save about $2 billion in reduced energy costs annually each year. By storing carbon, urban trees mitigate climate change and severe weather. Philadelphia's 2.1 million trees, for example, currently store approximately 530,000 metric tons of carbon at an estimated value of $9.8 million. Across the entire United States, urban trees currently store 770 million tons of carbon valued at $14.3 billion.

Stormwater Mitigation

Trees, other vegetation, and soils slow and filter stormwater. One hundred mature tree canopies intercept approximately 100,000 gallons of rainfall annually, significantly reducing stormwater management costs. In Philadelphia, for example, forested park land is estimated to save $5.9 million on water treatment costs each year. Conversely, the loss of 16 percent of Houston's tree canopy over the last three decades has resulted in a loss of $237 million in stormwater management services that trees provided.

Air Quality

Urban trees across the country remove about 780,000 tons of air pollution annually with a value of $3.8 billion. Some trees capture greater amounts of contaminants and carbon than others, which is one consideration when selecting tree species for planting in urban areas.

Trees help cool the "heat island effect" in urban areas. (Photo: Phillip Rodbell, U.S. Forest Service)

Did You Know?

A single, large shade tree can provide the following benefits each year:

- Saves $29 in summertime air conditioning by shading a building and cooling the air (250 kWh), about 9 percent of a typical home's annual air conditioning cost.
- Absorbs 10 pounds of air pollution, including 4 pounds of ozone and 3 pounds of particulates. The annual value of pollutant uptake by a single tree is $45 using local market prices of emission reduction costs.
- Intercepts and evaporates 760 gallons of rainfall in its own crown, thereby reducing stormwater runoff and flooding (valued at $6 a tree based on municipal expenditures for stormwater control).
- Reduces atmospheric carbon dioxide by the amount produced by a car driven about 400 miles.
- Cleans 90 pounds of carbon dioxide and 10 pounds of air pollution from the atmosphere through direct sequestration in wood as well as reduced power plant emissions.

Annual Energy, Carbon Sequestering, Air Quality, Stormwater, and Aesthetic Benefits of Trees in Lawrence Township, Pennsylvania

In 2011, i-Tree (http://www.itreetools.org/) inventory calculations estimated that 162 street and park trees located in Lawrence Township provided $49,400 in net ecosystem services. The trees:

- Saved 23.3 MWH of electric energy valued at $28,375 and 8,209 natural gas therms valued at $8,490.
- Sequestered a total of 120,545 pounds of carbon valued at $11,297 using a trading value of $12/ton in January 2011.
- Removed 147 pounds of ozone, 62.8 pounds of nitrous oxide, 30 pounds of sulfur dioxide, and 72 pounds of particulates worth $2,835.
- Intercepted 598,003 gallons of stormwater, providing $4,784 in stormwater management savings.
- Provided $10,773 in aesthetic benefits.

Active exercise and passive recreation help people ease their stress and be healthier.

Health Benefits

Trees and parks provide ecosystem services crucial for human health.

Psychological

Trees and other natural landscapes help satisfy a person's basic psychological and emotional needs. People find relief from crowding in green places that provide solitude, escape, and spiritual and aesthetic sanctuary. Encounters with nature—even simple views of nature—bring mental relaxation and aid in recovery from the cognitive and emotional fatigue that can result from the stresses of daily life.

Green places help satisfy a person's basic psychological and emotional needs.

Physical

The California Department of Health estimated that physical inactivity costs the State $13.3 billion a year in medical costs and lost productivity. According to those estimates, Californians could save more than $1.3 billion in health-related costs if they lost 5 percent of their weight, collectively, over 5 years. Trees and parks provide opportunities for active exercise and passive recreation, which in turn helps people ease their stress, reduce their weight, and be healthier through increased exercise. Studies have shown that people who view and interacted with nature have reduced stress responses, greater interest and attention capacity, better productivity, improved moods, and decreased feelings of anger and aggression. Hospital patients recovering from surgery who simply viewed trees through their windows required less pain relief, experienced fewer complications, and left sooner than similar patients with a view of a brick wall.

Children

Contact with nature helps relieve symptoms of Attention Deficit Hyperactivity Disorder in children; kids with this condition are better able to concentrate, complete tasks, and follow directions after playing in natural settings.

Contact with nature helps relieve symptoms of Attention Deficit Hyperactivity Disorder in kids.

Economic Benefits

While discussing an increase in tax and tourist dollars in the 1860s, famous city planner and landscape architect Frederick Law Olmsted wrote that enterprising cities would reap great economic benefits from great parks. Over the 150 years since then, the economic boost to residential and business property values provided by parks and other public landscapes has been well documented. These values can also have significant impacts on property and sales taxes.

Property Values

Public trees, parks, and open space can raise property values from 5 to 20 percent in municipalities that provide these public services. A Trust for Public Land 2007 study found that Philadelphia properties within 500 feet of parks were worth an average of 5 percent more, providing a total increase in value of $688.8 million and additional property taxes of more than $18.1 million. Recent studies by the University of Pennsylvania found that planting a tree within 50 feet of a house can increase its value by 9 percent, and that cleaning and greening vacant lots can increase adjacent property values by as much as 30 percent. Studies of large planned open space systems (for example, the city of Thousand Oaks in California and the Conejo Open Space Conservation Agency) indicate that those systems increase the value of all properties in the city, not just ones in direct proximity to open space.

Increased Business

The presence of public landscapes and parks also enhances public appreciation for the quality of commercial and other business areas. For instance, University of Washington researchers found that trees were good for business and shoppers stayed longer, visited more frequently, interacted with business owners more, and were even willing to pay higher prices for parking and goods in landscaped business areas.

Reduced Municipal Costs for Services

Research from Purdue University and Penn State suggests that industrial and commercial development tends to have positive tax and other fiscal impacts, while residential development tends to bring added municipal costs for services such as education, public safety, and transportation. In many situations, the cost of providing those services to new subdivision development exceeds the revenue from an expanded tax base. Studies by the American Farmland Trust have shown that the planned conservation of open space and parks, rather than intensive land development, can reduce municipal costs associated with subdivision.

Societal Benefits

The many ecosystem services provided by trees and parks also encompass a wide array of benefits to people and the communities in which we live.

Public parks provide places for families to recreate.

Public trees and parks provide an outdoor classroom for kids.

Family

Since youth are the foundation of any community, families and children need supportive and healthy environments to encourage positive behaviors and provide a respite from the challenges of life. Public landscapes and parks provide families places for talking, visiting, and recreating. Studies have shown that families living in Chicago public housing that had more trees and green space had healthier patterns of children's play, experienced fewer violent crimes and incivilities, were more constructive, used less violent methods to deal with family conflict, and exhibited less physical violence with partners. Contrary to the views of many law enforcement and public works officials, the planting and correct maintenance of trees and other vegetation increases people's sense of safety and welfare in inner-city neighborhoods and decreases feelings of fear and anxiety.

Educational

Public trees and parks foster an appreciation of nature among urban residents; provide outdoor classrooms (rooms with a view); and offer settings for interaction among teachers, children, and families. Natural landscapes in highly urbanized areas can create suitable and safe play spaces for children—places not overwhelmed by concrete and asphalt. Both the amount and creativity of play are greatly increased in schoolyards and other landscapes containing trees, plants, and grass. The trees in public landscapes may be the only "forests" that some people ever experience, which provides a context for the creation of values and ethics that urbanites place on the natural environment as a whole.

Scientific

Aldo Leopold said, "Open space provides the perfect norm for evaluation." Open space can be used to maintain and protect biodiversity and the natural influences and resources of flora and fauna and supply a "control" for the evaluation of research and urban existence.

Historical and Cultural

Open space and greenways can be used to preserve and protect archaeological and other cultural resources as well as remnant natural landscapes (for example, the Coastal Mediterranean Chaparral Ecosystem in California) in and near urban areas.

Ethical Responsibility

Preserving natural resources is an extension of human sensitivity to and concern for the natural world. It is an attempt to bring our species and nature into some sort of reasonable balance and improve our relationship with the natural world.

Preserving natural resources is an extension of human sensitivity to the natural world.

Sense of Place

The natural environment of a municipality plays a significant role in the healthy and successful social lives of people by providing many things, including shared and structured symbols. These symbols (historical landscapes, important views, trees, hills, streams) help ground people in their everyday lives and, as change occurs, provide a consistent and familiar sense of place and comfort. With proper planning and management, municipal trees and parks serve as shared and structured symbols that help form the features and shape the identity of a place, invoking pride, attracting outside attention, and stimulating economic activity.

Community Development

Trees and other natural features serve as fundamental elements in developing the process of community in four ways:

1) Landscapes such as parks, open spaces, and tree-lined streets provide places for humans to interact.

2) The natural environment in planned open space, parks, and greenways reinforces the unique physical realities of a locality. Nature can be used to provide distinction to communities and neighborhoods amidst a sprawling wave of suburban development.

3) Because decisions about land use and development can be at the heart of community conflict, encouraging and empowering people to become jointly involved in decisionmaking (through public hearings, development review, ad hoc and standing committees, even public protest) supports the interactional component of community.

4) Nature can be used to support volunteer and educational opportunities, which builds both social interaction and individual human capacity.

Nature can bring people together as volunteers in a project.

Case Study — Ecosystem Values in Oregon's McKenzie Watershed

A panorama of the McKenzie River from Armitage County Park near Coburg, Oregon. (Photo: http://en.wikipedia.org)

A study by the Eugene, OR, Water and Electric Board and Earth Economics provides an economic characterization of ecosystem goods and services found in the McKenzie watershed. The watershed spans forests, rivers, lakes, wetlands, grasslands, shrub, snowpack, and agricultural lands. Ecosystem goods and services include drinking water for 200,000 people, fish, timber and agricultural products, flood protection, hydroelectric power, recreation, and local weather and climate stability. Using benefit transfer methodology (BTM) and geographic information systems data, these services were identified and valued. BTM (http://www.ecosystemvaluation.org/benefit_transfer.htm) is used to estimate values for ecosystem services by adapting an estimate completed for another location.

For the assessment, the watershed was divided into 10 land cover types using geographical information systems data: agricultural lands, pasture, forest (five age groups), riparian buffer, urban green space, grassland, shrub/scrub, lakes/rivers, wetlands, and other. Each natural land cover across the watershed produces a unique suite of up to 23 ecosystem services. Ecosystem services were identified for nine of the land cover types, and a subset of these services was assigned dollar values using BTM. The ecosystem services examined included climate stability, flood protection, water filtration and supply, wildlife habitat, soil erosion control, and recreational value.

This initial estimate showed that the value of economic benefits provided by the McKenzie Watershed is enormous. In a conservative analysis, results demonstrated that watershed ecosystems provide between $248 million and $2.4 billion in benefits to the regional economy each year. The range is wide, but will narrow with more detailed analysis of key ecosystem services and land cover types, and as spatial mapping of the watershed's ecosystem services is completed. The low end of the range can be considered a baseline value and an underestimate. The following steps are recommended based on the study findings:

- **Invest in natural capital.** The conservation and restoration of ecosystems is a key asset and investment opportunity for promoting economic prosperity.
- **Conduct detailed valuation, mapping, and modeling of key ecosystem services.** Detailed valuation studies help support cost-effective investments. Sophisticated maps show geospatially where specific ecosystem services, such as drinking water quality or flood risk reduction, are and who benefits from those services.
- **Review institutional options for managing natural assets.** It is important to fund institutional improvements that support ecosystem services, including drinking water quality, salmon habitat restoration, recreation, stormwater conveyance, and forest stewardship.
- **Use ecosystem services to advance rural economic development.** By including agriculture, sustainable forestry, and access to quality outdoor recreation in economic development planning, long-term and sustainable jobs continue to be identified, quantified, and secured.
- **Include ecosystem service valuation in accounting and decisionmaking tools.** The value of ecosystems should be correctly measured and considered in decisionmaking. The creation of macroeconomic measures, such as measures for the Gross Domestic Product, transformed the United States because these measures enabled better economic decisionmaking. Correct ecosystem service valuation provides governments, organizations, and private landowners a way to calculate the rate of return on conservation and restoration investment.

Schmidt, Rowan; Batker, David. 2012. Nature's value in the McKenzie Watershed: a rapid ecosystem service valuation. Earth Economics: Tacoma, WA. http://www.eweb.org/public/documents/water/EarthEconomics.pdf. (18 April 2013).

Relevant Factsheets

A1 – *Using Smarth Growth Principles to Plan Sustainable Communities* – Principles of smart growth are used to increase and protect ecosystem processes and services.

N1 – *Developing a Natural Resource Assessment* – Assessments allow municipalities to locate and describe important resources and determine the best tools (e.g., open space referendum) for conserving ecosystem services.

N2 – *Comprehensive Planning for Natural Resource Conservation* – Comprehensive plans should identify and discuss the benefits nature provides to a place and to the people who live there, as well as strategies and tools for conservation.

N3 – *Regulatory Approaches to Protecting Natural Resources* – Zoning and other ordinances enhance ecosystem services by protecting riparian areas and other important landscapes.

N4 – *Nonregulatory Approaches to Natural Resource Conservation* – Open space acquisition, public education, and other nonregulatory approaches enhance ecosystem process and services.

Resources

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