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Ecosystem Services Decision Tree

A Decision-Support Tool for Consideration of Ecosystem Services in the Electric Power Industry

2012 TECHNICAL REPORT

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Abstract

Abstract
To support the electric power industry in more structured consideration of ecosystem services, EPRI has developed this "Decision Tree" to determine why, when, and how to consider ecosystem services. EPRI anticipates that this Decision Tree will facilitate more efficient decision-making and action relating to ecosystem services.

Keywords
Ecosystem services
Corporate sustainability
Decision-support tool

Executive Summary

To support the electric power industry in more structured consideration of ecosystem services, EPRI has developed a "Decision Tree" to determine WHY to consider ecosystem services (e.g., stakeholder pressure, regulatory obligations, financial benefits), WHEN to consider ecosystem services (e.g., land sales/purchases, changes in land management protocols), and HOW to consider ecosystem services (e.g., what actions could be taken). EPRI anticipates that this Decision Tree will facilitate more efficient consideration, decision-making, and action relating to ecosystem services. The objective of this tool is to help a corporate manager identify the decision points at which ecosystem services should be considered, and to provide suggested actions to address ecosystem service concerns.

Over the last twelve years, EPRI member companies have made significant investigations in ecosystem services, but to date there has been little evidence of integrating ecosystem service factors into decision-making, even when investigation has indicated the potential for monetary return. This Decision Tree could help a corporate manager articulate to executive-level decision-makers clear reasons for considering ecosystem services and make suggestions for specific action.

This report draws on EPRI's past experience with applications of an ecosystem services approach, discussions and collaboration with EPRI Program 55 member companies, publically-available 'grey' literature (ecosystem service methodologies, tools, and analysis of corporate application), and best professional judgment. After presenting a summary of background information, the report presents the Decision Tree, along with instructions, illustrative examples, and key questions for each step of the Decision Tree.

The Decision Tree was developed for implementation by companies in the electric power industry, but may have applicability to other industries. The next step will be to pilot the approach. The pilot testing will help identify areas for further development, and revision of the Decision Tree.

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Section 1: Background

Since the 1970s, there has been a growing understanding of the link between human wellbeing and the health of ecosystems. Natural ecosystems provide important benefits that are essential to society and industry, including clean water, biomass, and flood regulation. These benefits are called ecosystem services. The application of the ecosystem services concept in decision-making has seen growing popularity during the past five years. While the concept stems from academia, agencies, environmental groups, and businesses are now testing approaches to identifying, valuing, and measuring ecosystem services for decision-making. Today, corporations are beginning to acknowledge their dependencies, impacts and opportunities related to ecosystem services.

Power plants rely on access to clean water, nutrient filtration and assimilation of wetlands, and a predictable climate. If the electric power industry had to pay for these free ecosystem services, the cost of power generation could be significantly impacted. EPRI is helping its members understand their role in using and protecting ecosystem services, thereby positioning the electric power industry to respond to regulatory initiatives and sustainability targets.

Even prior to the groundbreaking global Millennium Ecosystem Assessment that was released in 2005, EPRI has been active in assisting its member companies in understanding the significance of ecosystem services. At the outset, EPRI tracked activity in the field, and then began to develop research dedicated to individual services like climate regulation and access to water supply. As markets for ecosystem services like carbon sequestration, wetland and endangered species banking, and water quality credits developed, EPRI investigated the potential for EPRI members' involvement [1].

During the last 10 years, EPRI has applied its Strategic Resources EcoAsset Model (STREAM) to power company sites, conducted "eco-asset" analysis on at least 10 corporate properties, piloted the World Resource Institute's (WRI's) Corporate Ecosystem Services Review tool on American Electric Power's (AEP's) Rockport site [2], and is currently piloting the InVEST tool to model ecosystem services on AEP ReCreation Lands. In addition, other EPRI members have conducted their own evaluations. To date, one company, Allegheny Power, realized a direct monetary return from implementing actions based on EPRI's evaluations [1]. Others have enjoyed reputational value in the form of stakeholder communication and sustainability reporting, and a few identified corporate benefits that could have been pursued related to ecosystem services, but were not.

The experience noted here suggests that despite preliminary enthusiasm about the adoption of an ecosystem services framework, there is often lack of a solid business case for action. Even when there are projected financial returns, it is difficult to make an executive-level justification to pursue still nascent and sometimes nebulous financial opportunities.

Thus, this project aims to provide a logical approach for understanding WHY to consider ecosystem services (e.g., stakeholder pressure, regulatory obligations, financial benefits), WHEN to consider ecosystem services (e.g., land sales/purchases, changes in land management protocols), and HOW to consider ecosystem services (e.g., what actions could be taken).

1.1 Evolution of Approach

Prior to the start of this project, EPRI considered research to determine the best and most appropriate tools for modeling ecosystem services in relation to provisioning and/or impact and dependencies on the part of utility companies. EPRI sought to accomplish this goal by a detailed review of ecosystem service models (incorporating previous EPRI research on modeling tools), and a pilot application of a model by an EPRI member company.

In the last decade, interest in a more quantitative approach to looking at impacts to ecosystem services from on-the-ground land management decisions has spurred the development of evaluation models and tools. These tools generally are intended to be applied to support the identification, valuation, and tracking of ecosystem services. A few of these approaches attempt to identify metrics—specific measures of impact—to ecosystem services. Others are applied to generate a more generalized understanding of impacts and values. Appendix B provides the most comprehensive summary of these various tools to date.

EPRI initiated discussions on what kind of model or tool to test and how to integrate such an approach with existing corporate planning frameworks. Potential sites and criteria for choosing sites were discussed. EPRI members were interested in seeing a conceptual framework for applying a tool holistically across the organization ("top-down" approach), and for applying a tool at a site ("bottom-up" approach). As the EPRI team began to develop this approach, it became clear that the cost and time commitment of the tools (from 25-400 personnel hours or more to implement) could easily outweigh the benefits if the tool was not matched to desired outcomes, such as specific ecosystem service metrics or maps prioritizing services to assist with landscape management decisions.

"It is difficult to select tools for a specific site or set of conditions since at present there is no guidance on how to match tools with the types of questions that a company is asking, specific application contexts, and available data sets." (BSR, 2012) [47].

EPRI then began "back casting" to determine, based on the goal, the steps and considerations relevant before application of a specific, and costly ecosystem services model. While an ecosystem service model could be used to evaluate on-the-ground impacts of various land management scenarios, and possibly quantification of financial value of ecosystem services, a model is not likely to affect executive-level decision-making unless its application responds to underlying corporate motivations, goals, and targets. If the underlying target is

to identify ecosystem service actions that are backed by solid business justification, the first step would be to identify why (or if) taking an ecosystem services approach makes business sense to the company.

EPRI Program 55 member companies agreed to take a step back and modify the original project of applying an ecosystem service model. The new project became the development of a Decision Tree; a decision support tool for understanding WHY to consider ecosystem services (e.g., stakeholder pressure, regulatory obligations, financial benefits), WHEN to consider ecosystem services (e.g., land sales/purchases, changes in land management protocols), and HOW to consider ecosystem services (e.g., what actions could be taken including, when appropriate, use of ecosystem service modeling tools).

1.2 Why is the Decision Tree Needed?

As illustrated above, there is a depth of grey literature reports, guidance and tools on corporate application of ecosystem services. While there is a moderate amount of corporate investigation of impacts and dependencies on ecosystem services, as evidenced by the over 300 companies WRI cites are using the Corporate Ecosystem Services Review, adoption of ecosystem service action remains spotty [3].

Some reasons for low rates of corporate action could be:

- Current guidance does not acknowledge the 'real world' of corporate decision-making that require tangible business case reasons for adoption.
- Communicating a concrete business case for action to vice president-level decision-makers is challenging.
- Current guidance for ecosystem service evaluations is complex.
- Broad guidance does not translate well to specific industries or actions (although guidance targeted to sectors is beginning to address this gap).

The Decision Tree in this report is one step towards addressing some of these gaps. It is intended to:

- Focus on the few business case reasons for action that have been observed by EPRI in the electric power industry over the past decade.
- Provide clear logic for action (or inaction).
- Simplify the process of considering ecosystem services, including identifying key decision points and actions to take.
- Tailor guidance to the electric power industry.

Section 2: The Decision Tree

To support the electric power industry in more structured consideration of ecosystem services, EPRI has developed this "Decision Tree" to determine WHY to consider ecosystem services (e.g., stakeholder pressure, regulatory obligations, financial benefits), WHEN to consider ecosystem services (e.g., land sales/purchases, changes in land management protocols), and HOW to consider ecosystem services (e.g., what actions could be taken).The graphic on the following page shows the basic steps. Each step is further explained in the following sections, followed by "worked examples" of the Decision Tree.

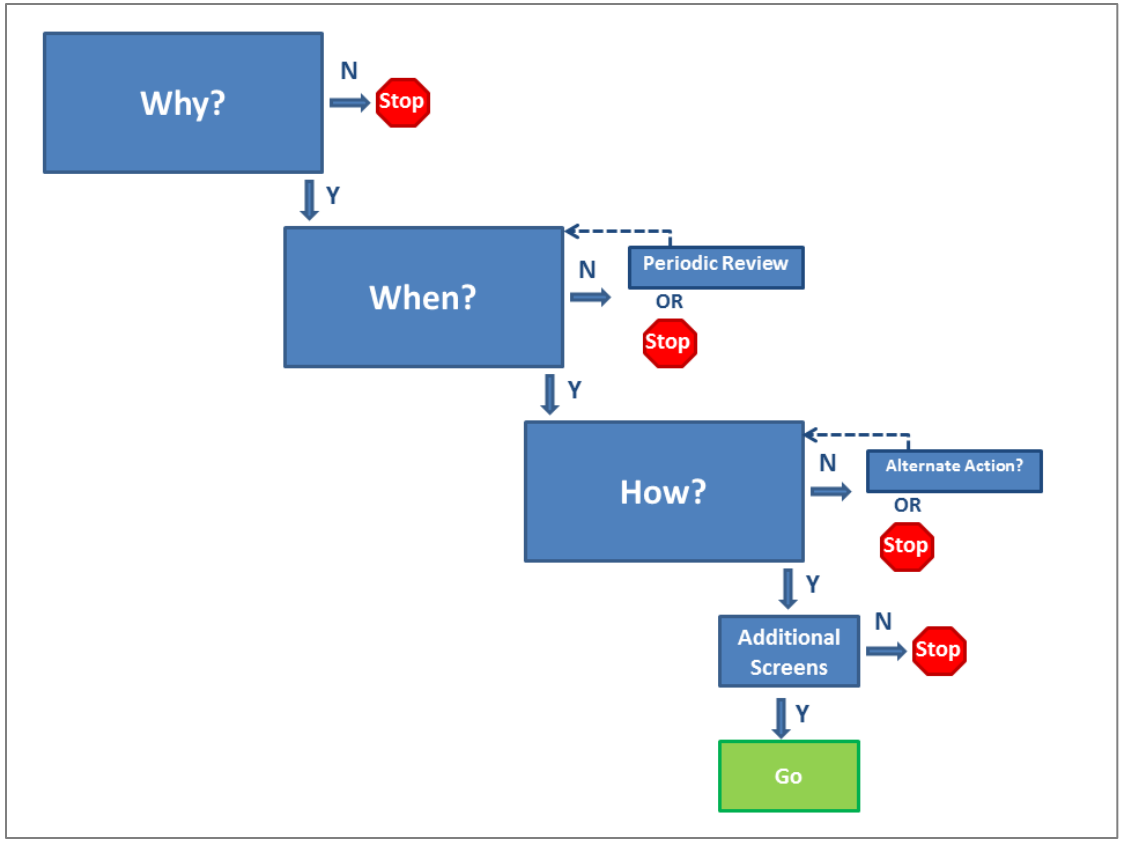

Figure 2-1
Decision Tree

Section 3: Step One: Why Consider Ecosystem Services?

The essence of the first step in the Decision Tree is establishing a business-based reason for consideration of ecosystem services. The perspective of this step is that it is necessary to establish a strong case that can gain executive-level support for company action. Without executive support, actions related to ecosystem services will be limited to hypothetical analysis rather than corporate action.

"How will an ecosystem services approach to business decision-making and operations translate into business revenues or societal benefits? Until this is clear, we won't act." -Anonymous Fortune 100 corporate manager [47]

The five basic business motivations for consideration of ecosystem services that EPRI has observed in the electric power industry are profit from environmental markets for ecosystem services, sustainability reporting benefits, investor requirements, threat of future regulations, and operational risks and opportunities. This section will go into detail on these motivations for actions to help a company determine if these reasons are relevant. If not, there may not be an immediate business reason for action on ecosystem services, unless other motivations are identified.

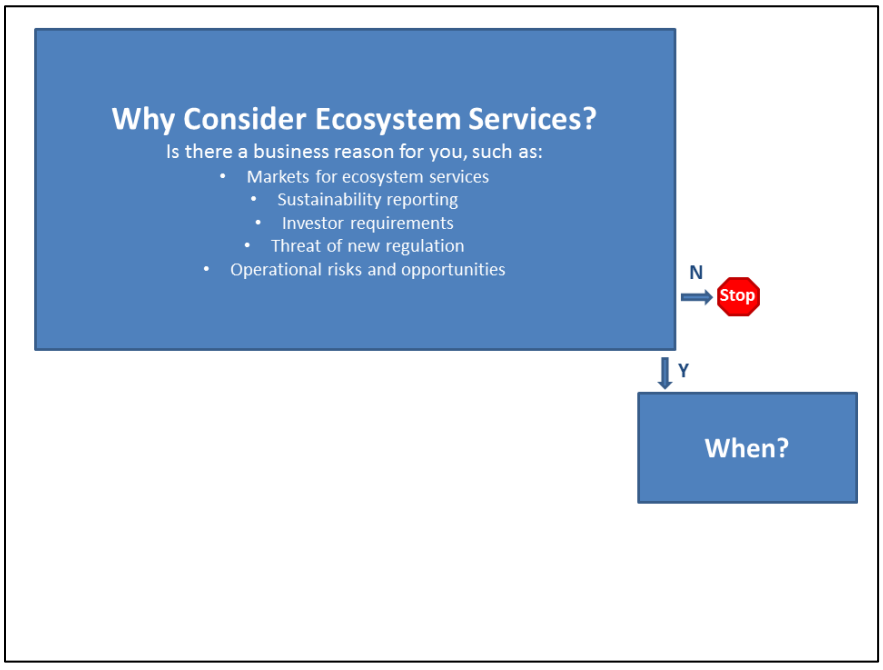

Figure 3-1
Decision Tree Step One

3.1 Markets for Ecosystem Services

Markets for ecosystem services create economic incentives for restoration and conservation. With the possibility of selling one acre of land for upwards of $300,000 or more, many investors and businesses have been drawn to environmental credit markets. There are four primary markets for ecosystem services: greenhouse gas credits, wetland and stream credits, endangered species banking, and water quality trading (see Table 3-1 below). All of the markets are driven by regulation or the threat of regulation. Generally, these markets reward restoration and conservation above and beyond the status quo by assigning property rights to "credits" that may be traded. Electric power companies may have the opportunity to create credits for ecosystem markets on corporate lands. For example, many wetland and conservation (species) banks have been developed by corporations to meet their own regulatory compliance needs more cost-effectively, and to create surplus credits that can be sold for a profit [4].

In addition to individual markets, there has been a great deal of discussion related to the potential opportunity for environmental credit "stacking." EPRI has conducted analysis of stacking and identified a consensus definition of stacking as "establishing more than one credit type on spatially overlapping areas" [5]. EPRI's national survey on stacking (conducted in 2010) found only one actual instance of a sale of both wetland credits and water quality credits created on the same land. However, this example was later protested strongly and ultimately disallowed. EPRI's Ohio River Water Quality Trading Project is testing the reality of stacking by vetting the creation of carbon sequestration credits and water quality trading credits from the same conservation practice (reduction of fertilizer use of farms). Theoretically, by stacking credits, the financial returns for engaging in a single conservation action could generate many hundreds of thousands of dollars, although this has yet to be demonstrated successfully on the ground [6].

Table 3-1
Primary Markets for Ecosystem Services (from EPRI, 2012) [1]

Natural Resource	Federal Guidance / Policy (Year)	Credit Currency	Total Annual Market Value	Credit Price Range
Carbon (global)	Pending	Pounds/tons CO_2e	$142 billion	$1-$20 per pound
Wetlands and streams (U.S.)	Mitigation banking (1995)	Acres	$1.8-$3.2 billion	$2,500-$653,000 per acre
Threatened and endangered species (U.S.)	Conservation banking (1995-California, 2003-Federal)	Acres and individuals	$200 million	$2,500-$300,000 per acre
Water quality (U.S.)	Water quality trading (2003)	Pounds of nutrients, or similarly specific credit	$10.8 million	$1.21-$10 per pound nitrogen $3.76-$25.16 per pound phosphorous

3.2 Corporate Sustainability Reporting

Consideration of ecosystem services is a subset of activities that fall into the general category of "corporate sustainability." Voluntary corporate sustainability reporting initiatives already capture some metrics of ecosystem services, and will expand this in the future. For example, the Global Reporting Initiative (GRI) currently includes metrics related to freshwater, global climate regulation, and habitat provisioning. The GRI's 2011 report *Approach for Reporting on Ecosystem Services* was catalyzed by public input requests and noted "This [stakeholder request] guarantees that this topic will be part of the discussions about the future of reporting on the impacts companies' activities have on ecosystem services [7]." GRI mentions "ecosystem services" within the Principle of Sustainability Context:

> *"2. The Principle of Sustainability Context emphasizes the necessity of considering impacts on sustainability. Impacts may be considered in absolute and relative terms.*
>
> *The Principle is intended to assess the organization's contribution to the environmental and social trends that are the focus of sustainability concerns.* ***Understanding the organization's impacts and dependencies on ecosystem services is also a part of 'Sustainability Context*** *[8]."*

Voluntary sustainability reporting presents a business case reason for action on ecosystem services, primarily based on evidence of a link between corporate sustainability and profits. For example:

- Businesses that improve their environmental management system and future environmental performance may be able to increase shareholders wealth by 5% [9].
- Tracking corporate performance for 18 years, Eccles et al [10] found that sustainable firms can outperform traditional firms in terms of both stock market and accounting performance.
- "Companies that ranked in the top 100 of the 2009 [Newsweek's Green Rankings], weighted equally, outperformed the S&P 500 by 4.8 percent over the last two years" [11]. Note that the Green Rankings only analyze the top 500 U.S. firms.
- The Dow Jones Sustainability Index has outperformed the Dow Jones Industrial Average over a ten-year period [12]. Note that the Dow Jones Sustainability Index only includes firms from the top 2,500 companies globally.

Investors and analysts use information like environmental disclosures to analyze performance and make investment decisions [13]. One way that companies can be transparent to investors is through voluntary reporting like the Global Reporting Initiative, Carbon Disclosure Project, or completing the Dow Jones Sustainability Index's Corporate Sustainability Assessment questionnaire, among others [14, 15, 16].

3.3 Investor Requirements

Ecosystem services are beginning to be incorporated in project screening in the financial sector. Access to capital has become a motivation for companies to examine and adapt their project's impacts on ecosystem services.

In January of 2012, the International Finance Corporation (IFC) released revised screening protocols for lending decisions. The IFC's Performance Standard 6 (PS6) "Biodiversity Conservation and Sustainable Management of Living Natural Resources" includes a new requirement that clients identify, avoid and minimize impacts on ecosystem services:

> *"Management of Ecosystem Services*
> *24. Where a project is likely to adversely impact ecosystem services, as determined by the risks and impacts identification process, the client will conduct a systematic review to identify priority ecosystem services…*
>
> *25. With respect to impacts on priority ecosystem services of relevance to Affected Communities and where the client has direct management control or significant influence over such ecosystem services, adverse impacts should be avoided. If these impacts are unavoidable, the client will minimize them and implement mitigation measures that aim to maintain the value and functionality of priority services. With respect to impacts on priority ecosystem*

services on which the project depends, clients should minimize impacts on ecosystem services and implement measures that increase resource efficiency of their operations, as described in Performance Standard 3. Additional provisions for ecosystem services are included in Performance Standards 4, 5, 7, and 8 [17]".

Subsequent to the IFC release of their revised performance standards, Equator Principles association members also adopted performance standards [18]. Equator Principles members are financial institutions that evaluate environmental and social risk of projects. There are 75 adopting financial institutions, including Bank of America, Citigroup, and Wells Fargo [19]. Business for Social Responsibility (BSR) has noted that the IFC and Equator Principles performance standards have created a large ripple of awareness and attention to ecosystem services with their members which are largely corporations with an international scope [Waage, personal communication, 2012].

While the IFC and Equator Principles banks' lending requirements have mainly affected international firms (and particularly, the extractive sector), the requirements could portend direction of the financial sector in the U.S. There have also been additional indicators of domestic attention to ecosystem services. Spurred by pressure from environmental groups, five banks (Chase, Wells Fargo, PNC, UBS, and Credit Suisse) have adopted policies on mountaintop removal mining practices [20]. Multilateral and nonprofit groups are advocating for the financial sector to consider water scarcity in lending decisions [21, 22]. At a more local scale, Fannie Mae/Freddie Mac have denied home loans near an Ohio lake experiencing toxic algal blooms [23]. This trend towards greater scrutiny of ecosystem services by the financial sector means that power companies may in the future be subject to liabilities related to ecosystem services.

3.4 Regulations

Regulations or potential future regulations may also create a business case for consideration of ecosystem services. Multiple U.S. laws already incorporate ecosystem services. Wetland impact permitting under the Clean Water Act incorporates functions of aquatic ecosystems in determining the amount of mitigation required. The Endangered Species Act regulates the ecosystem service of habitat provisioning. Climate regulation has seen international- and state-level regulation implemented, while discussion on national-level regulation continues. Finally, natural resource damage assessments use nonmarket valuation of ecosystem services to levy fines for catastrophic damages like the Deepwater Horizon spill in the Gulf of Mexico. These assessments are conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Oil Pollution Act [1].

Additionally, federal agencies are involved in a flurry of activity intended to improve institutions and legal safeguards to protect ecosystem services. The U.S. Environmental Protection Agency (US EPA) has tracked 334 federal agency projects related to ecosystem services [24]. Several of those projects investigate policies and regulations, while many others provide tools and topical research to

support policy decisions. One of these initiatives was the first policy application of an ecosystem service framework to setting secondary National Ambient Air Quality Standard (NAAQS), conducted by the US EPA [25]. Finally, U.S. Department of Agriculture (USDA) grant recipients are frequently required to complete a form predicting the impacts to natural resources, including ecosystem services, related to the project both during the time period of implementation, as well as into the future.

3.5 Operational Risks and Opportunities

Although we have identified ecosystem markets, sustainability reporting, investor requirements, and regulations as the primary business case reasons for consideration of ecosystem services, operational risks and opportunities are also frequently referred to in grey literature around ecosystem services.

Operational risks and opportunities refer to risks related to disruption of inputs in a company's day-to-day activities and processes. Investments in ecosystem service inputs that the company is dependent upon (e.g., water supply and quality, biomass) may ensure continued access to these inputs without having to invest in costly technological substitutions [1]. While there may be real risks to electric power companies in having access to the ecosystem services on which their operations depend, these risks are generally perceived to be so far into the future that there is no compelling driver for impact immediate corporate decision-making. It is difficult for executive decision-makers to prioritize the mitigation of a future and uncertain threat, like reduced access to cooling water, compared to other well known, easily identified and immediate business threats.

Step One Conclusion: By the end of this section (Section 3), you may be able to identify whether there is a business case for considering ecosystem services. Use the checklist below as a framework (Table 3-2), along with other company-specific questions that you may have identified. Note that it may take larger investigation to answer the questions in Table 3-2, and EPRI has completed many extensive projects to assist electric power companies to answer these same questions. The questions related to markets for ecosystem services, regulations, and operational risk may be particularly difficult to answer without a more thorough evaluation. However, these are the questions that will likely be the most useful for identifying if there is an underlying business reason for conducting a more detailed ecosystem service evaluation, as described in the WHEN and HOW sections of this report.

If you can identify a business reason for considering ecosystem services, continue to the next section. Otherwise, you can consider stopping here.

Table 3-2
Questions Regarding the Business Case for Considering Ecosystem Services

Markets for Ecosystem Services	
Do you own lands that could provide environmental uplift with restoration and preservation?	☐
Do you have regulatory requirements that could be met using company-owned ecosystem market credits for mitigation?	☐
Is there a favorable demand and supply scenario for the ecosystem credit development in your area?	☐
Sustainability Reporting	
Are you a publically-traded company?	☐
Only the U.S. 500 or Global 2,500 companies are considered in Newsweek Green Rankings and the Dow Jones Sustainability Index (respectively). Are you included in one or both of these groups?	☐
Do you have environmental reporting requirements or obligations?	☐
Does your company participate in sustainability reporting such as a corporate sustainability report, Global Reporting Initiative reporting, or the Carbon Disclosure Project reporting?	☐
Do you have stakeholder issues that could benefit from communication of ecosystem service projects, analysis, and/or conservation?	☐
Investor Requirements	
Do you, or could you in the future, apply for funding from financial institutions which screen for impacts on ecosystem services?	☐
Threat of Future Regulations	
Are there foreseeable regulations related to ecosystem services?	☐
Operational Risks and Opportunities	
Do you understand what ecosystem services your organization relies upon and your operational risks if those ecosystem services were no longer provided, or were no longer free? If you answered "no," check box.	☐

Section 4: Step Two: When Do You Need to Consider Ecosystem Services?

Even after a power company has identified why it should consider ecosystem services, determining when to apply an ecosystem services view in a task-oriented workplace is challenging. Step 2 of the decision tree will assess WHEN specifically it is appropriate to consider ecosystem services. The decision points discussed here may overlap with the previous section somewhat. The distinction in this section is to move from the underlying motivation to a time-sensitive catalyst. Thus, the threat of new regulations may provide a business reason as well as a point in time to integrate ecosystem service considerations.

For the second step of the Decision Tree, a corporate manager could identify if one of the following key decision points will trigger the need to consider ecosystem services:

- Sale, donation, or purchase of land.
- Change of environmental or land management policy.
- Siting operations or facilities.
- Response to stakeholder concern.
- Response to regulation.

Each of these points is described in detail below.

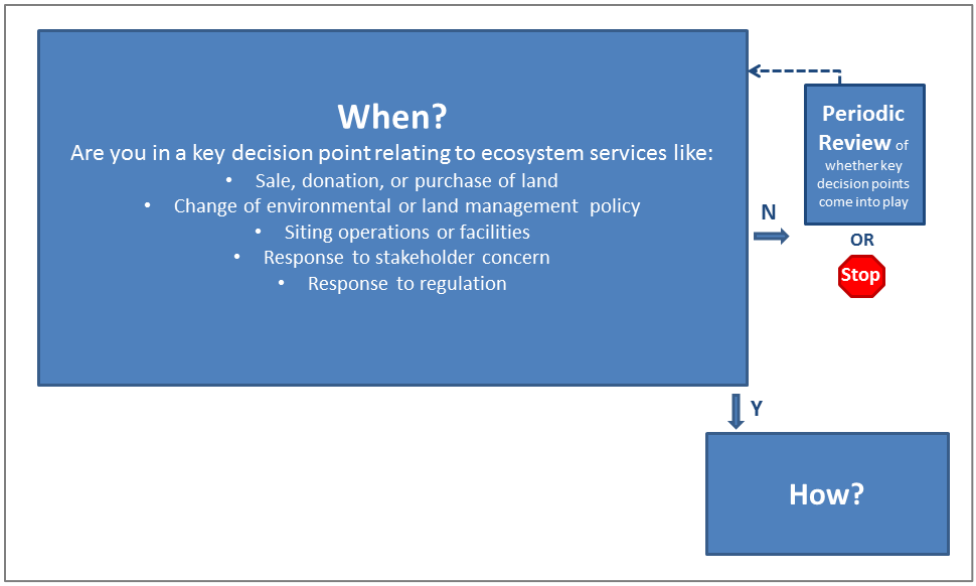

Figure 4-1
Decision Tree Step Two

4.1 Sale, Donation, or Purchase of Land

Before selling corporate land, there may be an opportunity to analyze the eco-assets of the land to determine if they outweigh the traditional real estate value of the land. For example, ChevronTexaco expects to realize $150 million in sales of wetland credits at an exhausted drilling site that supports 6,918 acres of wetlands that ChevronTexaco restored [26]. Prior to selling a former manufacturing site, DuPont investigated the site for ecosystem services opportunities. Among options considered for the site was developing an endangered species or wetland mitigation bank, donating, or selling the land [27]. Invasive species issues made mitigation banking a challenge, so DuPont is now in the process of making a decision about whether to sell or donate land.

In 2001, Allegheny Power considered ecosystem services before making a significant land management decision. Through an EPRI project, Allegheny Power realized over $5 million in tax savings when it took into account the value of ecosystem services before donating the property for conservation (see full case study in Box 4.1. below). Cargill Salt Company similarly found significant tax savings from a valuation and donation of land. Cargill based the value of their 16,500-acre former salt pond parcel on the value of the land for wetland and species mitigation banking, instead of traditional real estate valuation. In 2009, Cargill concurred with an IRS audit on the value of the land at $200 million. They sold the land to the U.S. Fish and Wildlife Service for $100 million and claimed the $100 million difference as a tax deduction [28].

When companies are purchasing land, they may also consider the presence or lack of ecosystem services relative to the corporate opportunities and liabilities they would like to acquire. Barrick Gold, for example, has an internal

Biodiversity Standard that requires the company to "assess the direct and indirect impacts of new projects (and expansions of existing projects) on ecosystem services [29] ".

If your company is considering a sale, donation, or purchase of land, it may be appropriate to consider ecosystem services.

4.2 Change to Environmental or Land Management Policy

Ecosystem services could be incorporated when changing internal environmental policy. For example, in 2009 the Walt Disney Company adopted a long-term environmental goal of "net positive impact on ecosystems" [30]. Nestle has committed to a "no deforestation" target and created responsible sourcing guidelines [31]. Internal policies and strategies are considered positively in voluntary reporting like the Global Reporting Initiative, Newsweek Green Rankings, and Natural Value Initiative benchmarking [32, 33, 34].

For power companies that generally manage large amounts of land either as rights-of-ways, buffer areas around power plants, or in surplus landholdings, there are substantial opportunities to benefit from ecosystem services more actively as well as to hold liabilities as regulations develop for management and reporting. Therefore, there is an opportunity to consider ecosystem services during changes or reconsiderations of ongoing land management and maintenance. For example, in 2012 when AEP revised their field evaluation checklist for contracted land surveyors, they simultaneously considered inclusion of key questions that would trigger a deeper evaluation of ecosystem services. Positive answers to these key questions during the land surveys would initiate action by corporate managers to take another look at the site. With technical support from EPRI, AEP identified existing questions in their land survey checklist that could be proxies to ecosystem service values, and added questions that could be answered by general foresters who don't have particular ecosystem training, as follows:

- Existing Question: Are there any pits, ponds, or lagoons on or adjacent to the site?
- Existing Question: Is there a stream, pond, or marsh that might interfere with the use of the site?
- Existing Question: Is the site located in, near or adjacent to a commercial or industrial area?
- Added Question: Are there any wetlands or similarly flooded areas on the site?
- Added Question: In its current state, does the property support trees, grasslands, or wetlands that could be habitat for wild birds, snakes, frogs, or mammals?
- Added Question: Is the property more than 100 acres?

Rights-of-way present another opportunity for making changes to ongoing management to increase ecosystem services. Pollinator advocates and departments of transportation are researching potential right-of-way management practices to improve ecosystem services [35, 36, 37].

There may be opportunities to consider providing recreational opportunities on landholdings. For example, Tampa Electric provides a manatee viewing platform, Alabama Power supports hunting licenses, and Georgia Power and Southern California Edison provide recreational opportunities on corporate property [38, 39, 40, 41].

If your company is making a change to existing land management or environmental policies, it may be a good time to incorporate ecosystem service considerations or policies.

4.3 Siting of Operations or Facilities

There are many corporate examples of integrating consideration of ecosystem services during the siting of new operations. Aluminum mining and production company Alcan implemented an Initial Biodiversity Assessment and Planning tool to help site new refineries in Guinea [42]. British Petroleum's sustainability webpage notes "Projects implementing our environmental and social practices screen for potential impacts to sensitive or protected areas, endangered species and ecosystem services as part of the screening process conducted at the early planning stages, prior to accessing an area and beginning work [43]." The International Finance Corporation and Equator Principles financial institutions now requires consideration of impacts to ecosystem services in projects that it funds [17]. The World Resources Institute recently developed an Ecosystem Services Review for Impact Assessment which provides "steps to address ecosystem services in impact assessment, and associated tools [44]. " The siting and maintenance of power plants and associated infrastructure could trigger consideration of ecosystem services.

4.4 Stakeholder Concerns

Consideration of ecosystem services can stem from stakeholder concern. Dow Chemical realized $38 million in cost savings from building a wetlands and natural treatment pond instead of a traditional water treatment facility. The treatment wetlands provided both waste treatment and water filtration ecosystem services to Dow as well as habitat provisioning, while simultaneously addressing community concerns of former wastewater injection practices [45, 46]. Nonprofit groups have pressured banks to refrain from lending to mountaintop removal mining projects [20]. Business for Social Responsibility [47] provides another illustrative case study of an anonymous company:

> *"An environmental NGO asked one company to pay for the removal of nonnative species from a wetland and provide an easement on the land in question. Before deciding, corporate representatives engaged a team of outside specialists to collaborate with the NGO to conduct an independent assessment*

of the current wetland structure and function using a new site-level tool for assessing multiple ecosystem services parameters concurrently.

They found that while the structure was suboptimal in terms of presence of nonnative species, the function was strong, according to numerous ecological parameters. Based on the findings, the NGO revised its initial assumptions about the wetland dynamics. Further, both parties agreed that the disturbance that the restoration work would cause would likely undercut short-term performance of the wetland, without significant long-term improved benefit.

Overall, the application of this ecosystem services assessment tool led to the environmental NGO rescinding its request about corporate action on the wetland. It also shifted the internal corporate discussion to how best to use the funds to improve the ecological function of a specified area."

Stakeholder concern can also flow to a company's supply chain. Girl Scouts [48] have pressured their cookie-making parent company to use sustainably-certified palm oil, and Greenpeace [49] has developed multiple campaigns highlighting unsustainable sourcing and its impacts on ecosystem services like habitat provisioning.

4.5 Response to Regulation

Regulation provides a critical decision point for consideration of ecosystem services. Not only can ecosystem services provide a green infrastructure solution more cost-efficiently than a built infrastructure, but as noted earlier, agencies are beginning to consider direct regulation on impacts to ecosystem services. For example, several utilities that supply drinking water have invested in source water protection instead of costly water treatment plants that would be required under Clean Water Act regulations if water quality worsened [50]. EPRI's Ohio River Water Quality Trading Project is an innovative and proactive approach to improving water quality to comply with future Total Maximum Daily Load regulations by putting conservation on the ground ahead of regulatory force [51]. Executive Order 13514 "Federal Leadership in Environmental, Energy, and Economic Performance" requires agency water efficiency improvements. As noted above, EPA is already looking at including ecosystem services as part of the National Ambient Air Quality Standard [25]. A related National Action Plan for Managing Freshwater Resources recommends that "nationally consistent metrics for key sectors [including thermoelectric power] expressing water withdrawal and use on a per capita, per acre, or per kilowatt basis should be developed [52, 53]. At the moment the Action Plan stresses voluntary action, but if government was to pressure for greater water efficiency in the future, the electric power sector could investigate a more cost-efficient ecosystem services solution. Finally, corporations may consider projected wetland or endangered species mitigation needs and develop environmental credits to meet projected regulatory needs. BP, for example, restored and enhanced wetland functions on its Cherry Point facility to compensate for projected wetland impacts [54]. Mining company Rio Tinto is investigating the use of non-operational lands for developing offsets for its impacts on biodiversity and ecosystem services [55].

Concern about current or future regulation could be a time-specific trigger for consideration of ecosystem services.

Step Two Conclusion: By the end of this section (Section 4), a corporate manager may be able to identify when to consider ecosystem services using the checklist below (Table 4-1). If you can identify any of the key decision points mentioned in this section, or you have relevant decision points not mentioned here, continue to the next section. Otherwise, you may consider stopping here and committing to a periodic review for future opportunities.

Table 4-1
Questions Regarding Key Decision Points for Considering Ecosystem Services

Screening Questions	
Are you selling, donating or purchasing land?	☐
Are you modifying environmental policies?	☐
Are you revising land management practices?	☐
Are you interested in maximizing ecosystem services on landholdings or right-of-ways?	☐
Are you making a siting decision?	☐
Are you conducting Environmental Impact Assessments?	☐
Can you address a stakeholder concern with an ecosystem services approach?	☐
Can you address supply chain concerns with sustainable sourcing that improves ecosystem services?	☐
Can you maintain or improve ecosystem services to avoid regulation?	☐
Are there cost-efficient ecosystem service solutions to meet a specific regulatory requirement?	☐
Do you have a current or predictable future mitigation requirement that could be met by generating environmental credits on your current landholdings?	☐

4.6 Case Studies

The following two case studies further illustrate when corporate managers faced key decision points related to ecosystem services.

Case Study 1: Donation of Land and Tax Savings for Allegheny Energy

From "An Overview of Ecosystem Services: Considerations for Electric Power Companies. [1]" (EPRI, 2012)

"A unique property appraisal allowed Allegheny Energy to turn ecosystem services like wildlife habitat, water purification and climate regulation into environmental assets. The project yielded millions in tax savings from a charitable donation to the U.S. Fish and Wildlife Service.

The project evolved from early EPRI investigation into the eco-asset valuation of Allegheny's landholdings. Alan Noia, CEO of Allegheny Energy noted 'We've known that some of our properties are truly unique, but it's always been very difficult to factor the intangible value of these physical assets into the land management equation [56].' In evaluating Allegheny properties, the natural value of the company's Canaan Valley properties became apparent. The valley's diverse and unique ecosystems support around 600 plant and 300 animal species, including the endangered Virginia northern flying squirrel, and the threatened Cheat Mountain salamander. The valley also hosts one of the largest wetlands east of the Mississippi.

The challenge, then, was in realizing the value of ecosystem services of this 12,000-acre tract, beyond traditional real estate valuation. The solution was a complex property transaction involving a sale of the property to the Fish and Wildlife Service. The transaction hinged upon a comprehensive appraisal of the property's fair market value. The appraisal included the value to eco-assets, specifically mitigation credits associated with protecting and enhancing wetland and endangered species habitat, preserving open space, and sequestering carbon. For example, the Canaan Valley property included 253 acres of degraded wetlands. If those wetlands were restored and turned into a wetland bank, credits could be sold for $8,000 per acre.

While the traditional real estate appraisal valued the land at $16 million, after including the eco-assets, the value rose to $33 million. The valuation was supported by an independent audit by PriceWaterhouseCoopers [57, 58] The U.S. Fish & Wildlife Service purchased the property at a cost in line with the traditional appraisal value. Based on bargain sale provisions in the federal tax code, Allegheny Energy claimed a charitable contribution of the eco-asset value, yielding about $5 million in tax savings. The transaction was reviewed by the Internal Revenue Service (IRS) during a tax audit, and was approved without modification. "This agreement will be beneficial from all perspectives," says Jay Pifer, president of Allegheny Power, the energy delivery business of Allegheny Energy. "The Fish & Wildlife Service will protect the public interest by managing and preserving this exceptional area as a wildlife refuge, Allegheny Energy will continue to demonstrate its strong commitment to environmental stewardship and community, and we will maximize the value of the property for our shareholders [59]."

Case Study 2: Response to Potential Regulation in the Oil and Gas Industry

A recent example in the oil and gas industry highlights action relating to ecosystem services in advance of regulation. The ecosystem service in question is provisioning of habitat for endangered species. In July of 2011, the Obama administration agreed to review 250 species for final listing as either threatened or endangered under the Endangered Species Act (ESA) by 2016. This mandate came in response to litigation on the part of non-profit organizations that the federal government was not doing enough to enforce the ESA. As shown on the map in Figure 4-2, the settlements could increase the number of species listed in all 50 states, a total increase of 16% by 2016 [60].

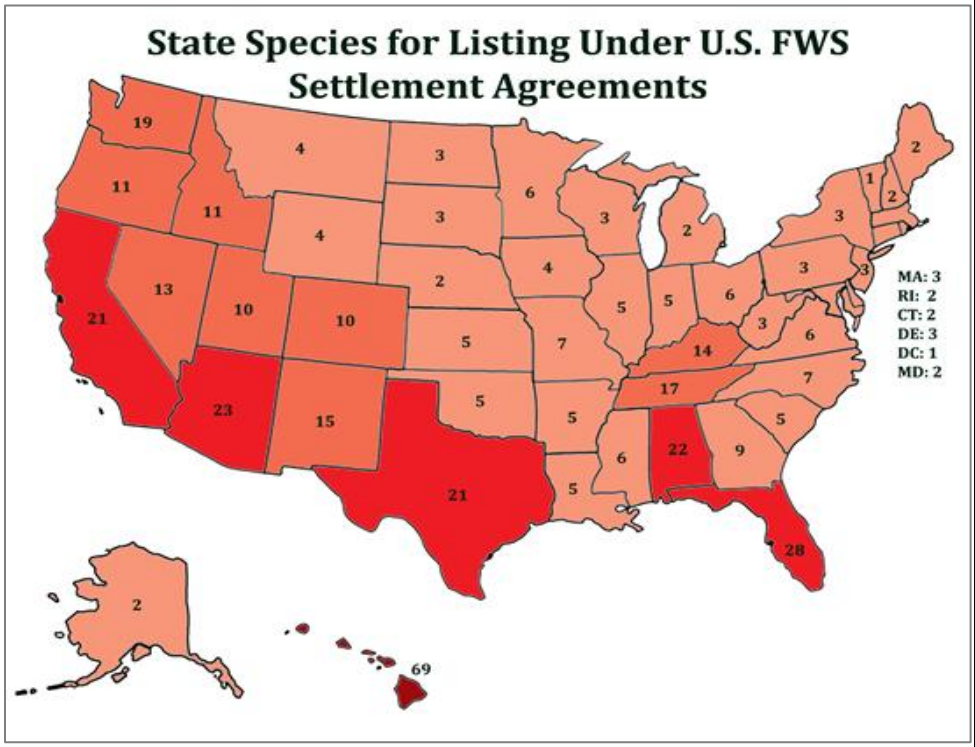

Figure 4-2
State Species for Listing Under U.S. Fish and Wildlife Service Settlement Agreements (Source: U.S. House Natural Resources Commission) [60]

For the oil and gas industry in western Texas, potential listing of species could restrict access and operations. The Dunes Sagebrush Lizard, for example resides in the Permian Basin, which is "bursting with new resource plays," according to an industry article [61]. If the lizard were listed, operations could be halted and the US Fish and Wildlife Service estimates that it could take a year to obtain a permit. Rather than face potential disruptions to operations, the oil and gas industry proposed to enter into a Candidate Conservation Agreement with Assurances (CCAA) with the US Fish and Wildlife Service. As a result of the CCAA, around 95% of the lizard's habitat in New Mexico and over 70% in West

Texas are protected. Dr. Benjamin Tungle, the Southwest Regional Director of the US Fish and Wildlife Service, notes that the assurances of the CCAA mean that "…they've committed to doing these conservation goals, objectives, and standards, and that's all they'll have to do [62]." Contracts under the CCAA require operators to avoid habitat and buffer areas, and if impacts are unavoidable, to pay a fee into a habitat restoration fund [63].

The US Fish and Wildlife Service is already reviewing many of the 250 species planned for review [64]. For those not yet under review, companies may have an opportunity to engage in pre-compliance activities to both assure habitat provisioning and access to current or future operations.

Section 5: Step Three: How to Consider Ecosystem Services?

The final step of the Decision Tree focuses on HOW to consider ecosystem services. This section presents a menu of action items. If any of the actions address the "decision point" described above, the action has good potential, but further screening questions are described. If the additional screens provide confirmation, then this final step leads to a carefully considered logical argument for Why, When, and How to consider ecosystem services.

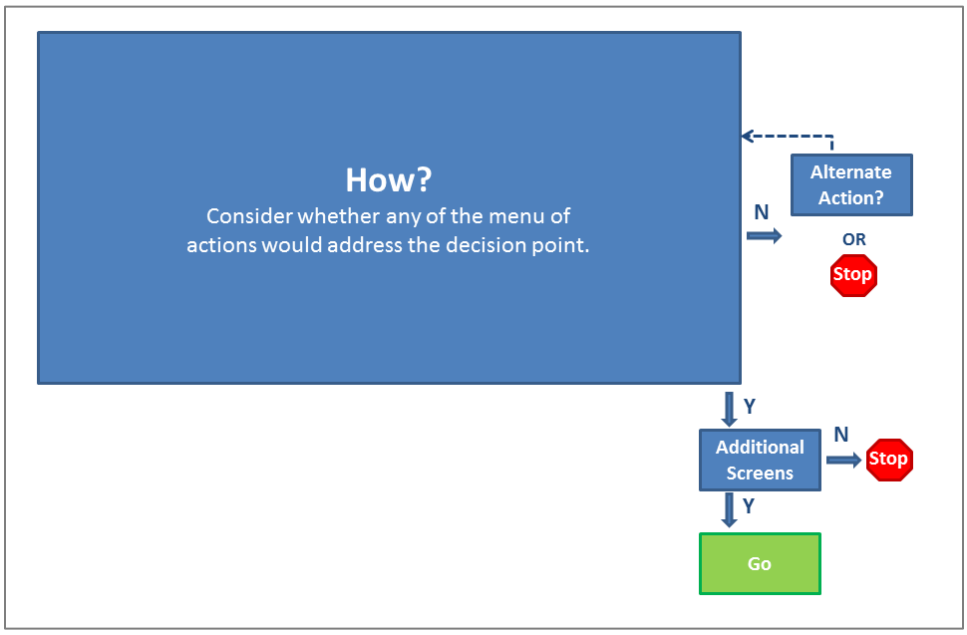

Figure 5-1
Decision Tree Step Three

The menu of actions listed in Table 5-1 is a sample of actions that are most relevant to the electric power industry. We provide a small sample of generalized actions in the table below, and a larger list of more detailed actions in Appendix A, "Additional Examples of Corporate Action on Ecosystem Services." More specific actions can be developed from the general actions below. For example, "Investigate ecosystem markets" could drill down to "Develop wetland bank on corporate land for internal needs." The actions were culled from multiple published examples and cases.

Table 5-1
Menu of Potential Activities Answering "How to Consider Ecosystem Services?"

General Action Item	Example	
Conduct ecosystem service appraisal to determine if tax savings could be realized.	Allegheny Energy (see Case Study 1 above).	☐
Participate in environmental markets.	Southern California Edison developed the Viejo Conservation Bank to mitigate for projected impacts [65, 66].	☐
Utilize ecosystem service modeling for land management or siting decisions.	LaFarge used the ecosystem service tool InVEST to determine current nutrient retention and potential to reduce siltation [67].	☐
Change land surveys to include consideration of ecosystem services.	American Electric Power (see Section 4.2. above).	☐
Incorporate ecosystem services into current Environmental Impact Assessments.	British Petroleum (see Section 4.3. above).	☐
Engage in voluntary goodwill actions.	BC Hydro funds environmental projects through their Fish & Wildlife Compensation program [68].	☐
Investigate alternatives to traditional environmental compliance.	An Oregon water utility saved $50 million by planting streamside forests to cool water instead of traditional chiller technology for a temperature TMDL [69].	☐

Note that although this project began with a focus on the use of ecosystem service modeling tools, the use of a tool is only one potential action in the menu of options. For readers interested in more detail on ecosystem service tools, we have provided an "Ecosystem Service Modeling Tools" in Appendix B.

If one or more action items from Table 5-1above address the decision point, continue to "additional screens" below.

If the action items above do not address the decision point, alternative actions could be considered. If there are still no action items that could address the decision point, stop further consideration of ecosystem services, but consider committing to a periodic review of whether key decision points have arisen.

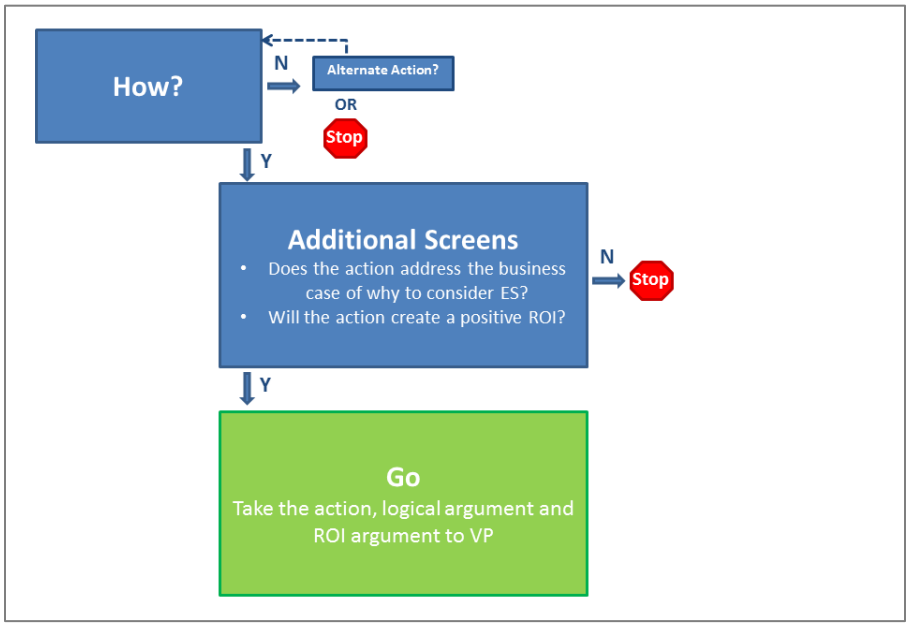

Figure 5-2
Decision Tree Step Three – Additional Screens

5.1 Additional Screens

Good actions both reflect a solid underlying business case for considering ecosystem services (Step 1: Why consider ecosystem services), and also meet with financial expectations of return on investment (ROI). An illustrative example is provided in Table 5-2.

Table 5-2
Screen One: Review Activity with Business Case

Action Item	Business Case Reason
Investigate ecosystem markets • Develop wetland bank on corporate land for internal needs	? Markets for ES Voluntary reporting √ Regulations

The second screening related to ROI is more complex because it requires consideration of the level of financial risk, investment, and return, which we bring together in a **risk/return screen** (see Table 5-3 below). This risk/return screen is a consideration that we have flagged for further research, but we present a framework here to initiate consideration in the Decision Tree approach.

Previous grey literature guidance on corporate application of ecosystem services has not focused on ROI, but we consider ROI an essential consideration as it helps focus limited staff time and resources on activities that have positive impacts on ecosystem services, meet internal corporate expectations, and can be assured executive support. Return on investment–particularly *immediate* returns–should not be considered in isolation. Instead of ruling out all activities without immediate ROI, it is important to consider activities where a low initial investment could yield a solid case for a positive ROI. For example, the price range for conducting a feasibility analysis for a mitigation bank could be $30,000, but a successful bank can yield millions of dollars in profit. The degree of investment and the level of return play a role in whether or not to undertake an activity.

"CEOs may complain that investors do not value their sustainability activities properly, but they need to tell investors what they are doing. If they don't communicate regularly, investors cannot incorporate these issues into their models."
- Edemir Pinto, CEO of Bovespa, the São Paulo stock exchange [701]

Risk of inaction also plays a role in whether or not to undertake an activity. If regulations are pending, there is a real risk of requiring the use of an expensive technological solution, unless a more cost-effective ecosystem services solution can be tested and proven to achieve comparative pollution reduction. Similarly, there may be highly visible stakeholder concerns that must be addressed.

There are other non-financial factors like stakeholder engagement or building relationships with regulators that should be considered. Since these factors cannot be quantified, they should be considered subjectively in the final go/no go decision.

The risk/return screen below can be used to explore whether an ecosystem services activity should be pursued or not. The screen is not comprehensive, merely illustrative.

Table 5-3
Screen Two: Risk/return Screen

Risk Considerations	
Risk of not taking action	□ Low □ Medium □ High
Initial investment	□ Low □ Medium □ High
Potential monetary returns	□ Low □ Medium □ High
Value of non-financial returns	□ Low □ Medium □ High
Conclusion	**□ Go □ No go**

5.2 Applying the Additional Screens

Table 5-4 shows a hypothetical example screening of action items with business case reasons and the risk/return screen.

Table 5-4
Example of Reviewing Action Items for Fit with Business Case Reasons and Risk/return

Action item	Business Case Reason	Risk/return Screen	Comments
Investigate ecosystem markets • Develop wetland bank on corporate land for internal needs	√ Markets for ES Voluntary reporting √ Regulations	Not taking action: low Initial investment: high Potential returns: medium Non-financial: medium **Conclusion: No Go**	Wetland regulations are already in place, and there are multiple mitigation options, so risk is low. The cost of a feasibility analysis is high and returns could provide modest savings over outsourced mitigation. With the existence of other banks, selling surplus credits will be difficult. It may be more reasonable to buy credits from an existing wetland bank.
Utilize ecosystem service modeling for land management or siting decisions	Markets for ES ? Voluntary reporting Regulations	Not taking action: medium Initial investment: high Potential returns: low Non-financial: high **Conclusion: Go**	In the presence of stakeholder concern (high risk), the investment of staff time to use ecosystem service modeling tools may equalize benefits. The modeling tool may provide quantitative information for voluntary reporting, with a chance of improving shareholder value.

Step Three Conclusion: If investigation has made it through all steps and the additional screenings, there are clear reasons for considering ecosystem services and concrete suggestions for action that can be articulated to vice-president level corporate decision-makers.

Section 6: Conclusion

This report presented a Decision Tree designed to support a corporate manager to determine WHY, WHEN, and HOW to consider ecosystem services.

This Decision Tree approach is by design simple. The simplicity is both its strength and its flaw. The Decision Tree does not review impacts and dependencies on *every* ecosystem service as other methodologies attempt to do. We hope, however, that its simplicity will lead to a compelling and logical case for adopting more activities beneficial to ecosystem services in the electric power industry. The final screen of the Decision Tree—consideration of risk, investment, and return—may prove the most difficult analysis in the process, and yet the most crucial to prove a solid business case for action. We have flagged this risk/return screening for further research and refinement, but retained the framework to initiate consideration within the Decision Tree approach.

Because the goal of the Decision Tree is use in the electric power industry, the most crucial next step is to pilot this decision-support tool. The pilot tests will inform the steps in the Decision Tree and the time investment required, and will indicate the utility of this tool in generating a solid business case for action and ultimate approval by executive decision-makers. Pilot companies may require technical support in evolving the Decision Tree into action. Finally, we anticipate that it may be useful to design a Decision Tree executive brief template that would simply, logically and graphically communicate the Decision Tree steps and actions for approval by executive decision-makers.

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Appendix A: Additional Examples of Corporate Action on Ecosystem Services

The menu of actions listed in the table below were culled from multiple reports and case studies of corporate action on ecosystem services [42, 47, 71, 72 73, and others].

'How' Activity	Example
Determine if wetland or conservation bank could be developed prior to selling land.	ChevronTexaco case (see Section 4.1).
Evaluate surplus properties for conservation potential.	ExxonMobil is evaluating its sites for "conservation easements, direct sale or donation to local land trusts, conservation banking, and wildlife habitat management [47]."
When purchasing new land or siting new operation, utilize ES modeling to avoid areas of high ES provisioning.	"Alcan has implemented an Initial Biodiversity Assessment & Planning tool to be used for the placing of new alumina refineries in Guinea [42]."
Adopt ES policy commitment, targets, sustainable supply-chain sourcing.	Following a Greenpeace campaign about unsustainable palm oil, Nestle committed to a "no deforestation" target (by 2020), created responsible sourcing guidelines, and built partnerships with NGOs [31].
Voluntary corporate reporting – GRI reporting framework.	AEP reports on Global Reporting Indicators, and was recognized in 2011 for corporate reporting [74].
Voluntary corporate reporting – internally-developed framework.	Weyerhaeuser's reporting includes 18 indicators of ecosystem services: wood products, clean water, soil productivity, habitat for fish and wildlife, hydrology, recreation and cultural benefits [72].

'How' Activity	Example
Voluntary customer CO_2 offset program.	Duke Energy provides customers with the option of offsetting their CO_2 footprint [75].
Offering recreational opportunities on corporate land.	Tampa Electric provides a manatee viewing platform, Alabama Power has hunting licenses, Georgia Power and SCE provide recreational opportunities [38, 39, 40, 41].
NGO partnership and positive publicity.	Dow Chemical has received publicity for their $10 million partnership on ES with TNC [76].
Building a wetland wastewater treatment facility	Dow Chemical (see Section 4.4).
Initiating water quality trading in advance of impending TMDLs.	EPRI's Ohio River Basin trading project (see Section 4.5).
Invest in candidate species conservation to preclude endangered species regulation.	The oil and gas industry protected dunes sagebrush lizard habitat to preclude more expensive regulations (see Case Study 2).
Research into "green infrastructure" solutions to storm water.	Cook Composites and Polymers is researching the financial and ecosystem benefits of natural storm water management [77].
Retain rights to ecosystem services in anticipation of future regulation/ market demand.	Canopy Capital bought the rights to market ecosystem services on a reserve in Guyana [78].
Explore water efficiency opportunities for operations in drought affected areas.	"Ingenio El Potrero sugar factory in Mexico invested in a more efficient cooling system that cut freshwater consumption by 94%, returning investment costs in two years [79]."

Appendix B: Ecosystem Services Modeling Tools

In the last decade, interest in a more quantitative approach to looking at impacts to ecosystem services from on-the-ground land management decisions has spurred the development of models. These models and tools generally are intended to be applied to support the identification, valuation, and tracking of ecosystem services. A few of these approaches take initial attempts to identify metrics–specific measures of impact–to ecosystem services. Others are applied to generate a more generalized understanding of impacts and values.

This Appendix is the most comprehensive summary of these various tools to date. It provides a literature review, and then summarizes the capabilities, approach, and application of all currently available tools and models related to ecosystem services.

Review of Literature and Tools for Corporate Ecosystem Services

"The solutions of the past are often not robust enough under the conditions of global change and need to be re-thought and re-implemented."
-Antony Burgmans, Chairman, Unilever [84].

While there has been a growing trend in peer-reviewed literature focusing on "ecosystem services" [80, 81, 82], very little of the work reflects corporate application of the concept. Armsworth et al. [83] noted that about 10% of 385 applied ecology journal articles on ecosystem services in 2008 could potentially be applied to business research needs and the majority of those papers focused on traditional rural industries like farming, fisheries and forestry.

Within the grey literature (e.g., published by government agencies, international bodies, and non-profit organizations), however, there have been far more publications relating to corporate applications of ecosystem services. There are two general types of publications in the grey literature: reports on the state of corporate application of an ecosystem services approach and/or compilations of case studies; and reports and tools in the public domain that aim to help corporations understand, measure, model, and value ecosystem services.

In the former category of grey literature, perhaps the first report relating ecosystem services to business was the Millennium Ecosystem Assessment synthesis for business [84]. The Millennium Ecosystem Assessment was essentially a global academic synthesis of the status and trends of ecosystem

services around the world. The business synthesis linked the Millennium Ecosystem Assessment to impacts on the bottom line via a business' license to operate, corporate reputation, access to capital, access to raw materials, operational impacts, and potential opportunities.

In 2010, multiple countries supported a global study on The Economics of Ecosystems and Biodiversity (or TEEB) with a 200-page report dedicated to business and biodiversity [71]. The TEEB business synthesis–echoing the Millennium Ecosystem Assessment business synthesis–pointed out the business case for action on biodiversity and ecosystem services and provided numerous case studies.

The European Commission funded a study in 2010 "How businesses take into account their risks related to biodiversity and ecosystem services: State of play and way forward." They reviewed the actions of 70 companies worldwide and categorized action as one of the following: ecosystem protection and restoration; biodiversity and ecosystem services risk assessment tools and sustainability indexes (i.e., screening out impacts); new business models; research and development; and resource efficiency. The report also included 11 case studies [42].

Also in 2012, the TEEB for Business Coalition released a report that ranked the top business impacts on natural capital with a heavy focus on water and greenhouse gas emissions [85].

At the 2012 Rio+20 event, The Nature Conservancy's Corporate EcoForum group released a report on "The New Business Imperative: Valuing Natural Capital" that echoed the same messages of the previous two reports and included 24 corporate commitments to taking action on ecosystem services or related sustainability topics [72].

"Companies that value and integrate biodiversity and ecosystem services into their strategic plans are best positioned for the future." -Andrew Liveris, Chairman & CEO, The Dow Chemical Company [47].

In addition to these global reports, multiple sector-specific assessments or guidance documents relating to ecosystem services were published. Nissan released a report on ecosystem services in the automotive sector in 2010 [86]. In 2011, the International Petroleum Industry Environmental Conservation Association (IPIECA), the global oil and gas industry association for environmental and social issues, released ecosystem services guidance which included a checklist for the industry [87]. The United Nations Environment Program-Finance Initiative recommended biodiversity principles for the finance sector [88]. There are also several benchmarking studies conducted by the Natural Value Initiative. The studies rank companies on their response to biodiversity and ecosystem services risks impacts within the extractive sector [73], pharmaceutical sector [89], and agricultural sector [90].

Finally, Business for Social Responsibility (BSR) released a synthesis report on public sector trends in ecosystem services in 2012 [91]. In the private sector, BSR released the "Quiet(r) Evolution in Corporate Environmental Performance," which noted:

> *"…business engagement is occurring along a spectrum—from companies that are only tracking the uptake of ecosystem services approaches within the public sector; through firms that are testing decision-making tools that assess the impacts, dependencies, and monetary value of ecosystem services; to businesses that are crafting corporate goals and policies to hold employees accountable for meeting new benchmarks in their work* [47]."

The second category of work in the grey literature is reports and tools to help corporations understand, measure, model, and value ecosystem services. The first tool in this space was the World Resources Institute's Corporate Ecosystem Services Review [92]. Released in 2008 (and updated in 2012), the Corporate Ecosystem Services Review is a methodology to conduct an initial assessment of corporate impacts, dependencies, and opportunities related to ecosystem services. The World Resources Institute reports that over 300 corporations have applied the Corporate Ecosystem Services Review [3]. The World Resources Institute has also recently released guidance on application of the Corporate Ecosystem Services Review for Environmental Impact Assessment which is being road-tested through 2012 [44].

The World Business Council on Sustainable Development spearheaded a deeper-dive methodology called the Corporate Ecosystem Valuation, released in 2011 [93]. This methodology begins with the prior-mentioned World Resources Institute's Corporate Ecosystem Services Review, but ends with guidance on how to value ecosystem services.

Alongside these two methodologies, various non-profit, government, and private organizations were developing multiple Geographic Information Systems (GIS)-based ecosystem service tools intended to map the provisioning, flow, and value of ecosystem services (among other uses). A small sample of these tools includes:

- InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) – developed by the Natural Capital Project (TNC, Stanford University, World Wildlife Fund, University of Minnesota), is designed to run with different scenarios of Land Use Land Cover (LULC) data and show you changes in flows of ecosystem services.
- ARIES (Artificial Intelligence for Ecosystem Services) – developed by the University of Vermont's Gund Institute (along with the Basque Centre for Climate Change, Conservation International, Earth Economics, Instituto de Ecologia), provides an online modeling platform that maps ecosystem service flows from provision to beneficiaries. ARIES uses data with probabilistic and deterministic models.
- ECOAIM (Ecological Asset Inventory and Management) – developed by Exponent, is a GIS optimization model analysis of rare species with a risk-analysis basis, including metric weightings of stakeholder preferences [94]."

Business for Social Responsibility provided an excellent comparative analysis of seven tools, but concluded that they were time-consuming and not well-suited to corporate application [95]. As another indicator supporting this conclusion, none

of the 120 examples of application of InVEST listed on the organization's website were corporate applications [96].

Summary Table of Ecosystem Services Tools

The information summarized in the Ecosystem Services Tool Overview was compiled by Madsen Environmental and is used with permission. Additional information on metrics was researched and added to the table below exclusively for this report. The majority of information in this Appendix draws from the Business for Social Responsibility report, "New Business Decision-Making Aids in an Era of Complexity, Scrutiny, and Uncertainty [95]," and the 2011 EPRI report *Program on Technology Innovation: Mapping and Modeling Tools for Strategic Corporate Management of Ecosystem Services* [97].

The "Metric or other outputs" and "Questions it can answer" were culled from information from the tool website, or in some cases, external reviews of the tools. When there is mention of "unknown metric outputs [of ecosystem services]" this is an indication that the tool includes these ecosystem services, but it is not apparent what kind of map or quantitative output is created by the tool.

Ecosystem Services Tools Overview

Methodologies Tools

Tools created to assist corporations in the process of identifying, valuing, and tracking ecosystem services.

Corporate Ecosystem Services Review (ESR)

What it does: The ESR is a "structured methodology to help business develop strategies for managing risks and opportunities arising from their dependence and impact on ecosystems." Provides explicit steps with guidance; an excel worksheet, slide decks, and other resources for implementing the process. Road-tested by 5 companies, now in use by over 300 companies.

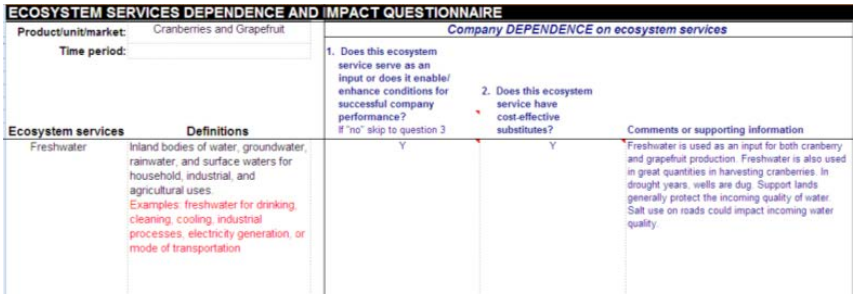
Corporate Application: For initial steps of exploration

Tool Highlight: Excel worksheet, training tools

Steps:

1. Select the scope
2. Identify priority ecosystem services
3. Analyze trends in priority services
4. Identify business risks and opportunities
5. Develop strategies

Screenshot:



ECOSYSTEM SERVICES DEPENDENCE AND IMPACT QUESTIONNAIRE

Product/unit/market:	Cranberries and Grapefruit	Company DEPENDENCE on ecosystem services		
Time period:		1. Does this ecosystem service serve as an input or does it enable/ enhance conditions for successful company performance? If "no" skip to question 3	2. Does this ecosystem service have cost-effective substitutes?	Comments or supporting information
Ecosystem services	Definitions			
Freshwater	Inland bodies of water, groundwater, rainwater, and surface waters for household, industrial, and agricultural uses. Examples: freshwater for drinking, cleaning, cooling, industrial processes, electricity generation, or mode of transportation	Y	Y	Freshwater is used as an input for both cranberry and grapefruit production. Freshwater is also used in great quantities in harvesting cranberries. In drought years, wells are dug. Support lands generally protect the incoming quality of water. Salt use on roads could impact incoming water quality.

Developers: World Resources Institute, in collaboration with the Meridian Institute and the World Business Council for Sustainable Development (WBCSD)

Year: 2008 (original), 2012 (v 2.0)

Time Investment: 6-13 weeks (full-time equivalent)

Link: www.wri.org/ecosystems/esr

Corporate Ecosystem Valuation (CEV)

What it does: Described as the 'next step' after implementing the ESR. CEV is "a process to make better-informed business decisions by explicitly valuing both ecosystem degradation and the benefits provided by ecosystem services." The guide emphasizes valuation of ecosystem services, but provides general written guidance as opposed to a 'calculator.' Road-tested by 14 companies.

Corporate Application: Useful in *identifying a method* to find the monetary value of an ecosystem service or value of trade-offs

Tool Highlight: Guidance on valuation methods

Steps:

1. Scoping [involves steps of ESR]
2. Planning
3. Valuation
4. Application
5. Embedding

Developers: World Business Council on Sustainable Development and four partners: International Union for Conservation of Nature (IUCN), World Resources Institute (WRI), ERM and PwC

Year: 2011

Time Investment: 10-138+ weeks

Link: http://bit.ly/CEV_report

The Economics of Ecosystems and Biodiversity (TEEB) for Business

What it does: TEEB for Business is not so much a tool as a reference. The report was a global effort to communicate the value of ecosystems broadly and provide a resource and inspiration for business action. It was not created as a step-by-step process, but provides a set of recommendations for businesses to take. It *could* be used to create a custom process for determining actions to take and exploring monitoring and valuation options. Downside: TEEB for Business is almost 200 pages long.

Corporate Application: Useful as a reference resource

Tool Highlight: Case studies, examples to inspire activity

Developers: UN Environmental Program (UNEP), EU Countries

Year: 2010

Time investment: undetermined

Link: http://www.teebweb.org/forBusiness/tabid/1021/Default.aspx

Geographically-Based Tools

Tools to aid in decision-making, or to express the total value of ecosystem services in monetary terms.

ARIES - Artificial Intelligence for Ecosystem Services

What it does: Online modeling platform that maps ecosystem service flows from provision to beneficiaries, based on land use land cover. Uses benefit transfer for values of ecosystem service provisioning. User can set priorities. The tool can link marine and terrestrial habitats. Uses data with probabilistic Bayseian and deterministic models. "ARIES is a web-based technology… to assist rapid ecosystem service assessment and valuation. Its purpose is to make environmental decisions easier and more effective... ARIES helps discover, understand, and quantify environmental assets and what factors influence their values "

Tool Highlight: maps source, sinks, and flows of ecosystem services

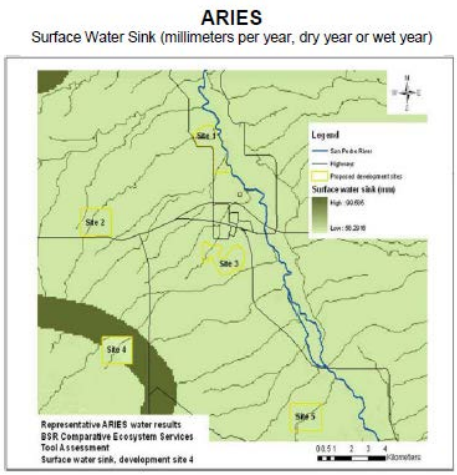
Developers: University of Vermont's Gund Institute and Ecoinformatics Collaboratory (United States), Basque Centre for Climate Change (Spain), Conservation International (United States), Earth Economics (United States), Instituto de Ecologia (Mexico)

Year: 2012

Time Investment: 5 weeks/200 hours

Link: http://www.ariesonline.org/ [also see journal article comparing InVEST and ARIES: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2990460/]

Screenshot:



Metric or other outputs:

- Maps of source, sink, use and flow of ecosystem services
- Carbon sequestration: the level of a region's net release or uptake of atmospheric CO_2
- Coastal flood regulation: maps areas capable of wave mitigation, maps potentially vulnerable populations, quantifies coastal flood regulation benefit, maps varying levels of coastal flood regulation service
- Fresh water supply (surface and groundwater): maps sources for different water users
- Unknown outputs of flood regulation, aesthetic viewsheds and open space proximity, sediment regulation, subsistence fisheries, recreation
- Dollar values of ecosystem services
- Model background information like lists of the probabilistic models built by AIRES, journal article sources of model assumptions, etc.

Questions it can answer:

- Spatial assessments and policy planning
- Optimization of payment schemes for ecosystem services
- Prioritizing areas of ecosystem services flows to communities – for conservation, or for locating areas for mitigation/offsets
- Comparing tradeoffs between extractive resource use and ecosystem service provision
- Predicting changes to ecosystem services under various potential climate futures
- Comparing levels of flood regulation or coastal damages between scenarios to manage green infrastructure vs. gray infrastructure
- Exploring tradeoffs between water use among different sectors and how changes in land use, public land management, and climate change impact regional water supplies
- Assessing the benefit of existing vegetation in erosion control or the benefits of increasing vegetation cover

ECOAIM - Ecological Asset Inventory and Management

What it does: GIS optimization model analysis of rare species with a risk-analysis basis, including metric weightings of stakeholder preferences. A new tool "to (1) inventory ecological services and help in making decisions regarding development, transactions, and ecological restoration; (2) develop specific estimates of ecosystem services in a geographically relevant context, and (3) offer the means for evaluating tradeoffs of ecosystem services resulting from different land or resource management decisions."

Tool Highlight: maps a combined biodiversity score

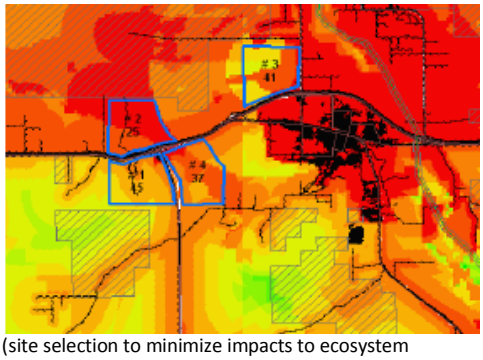
Developers: Exponent

Year: 2010

Time Investment: 25 hours

Link: NA, but presentation about tool available at: http://conference.ifas.ufl.edu/aces/Presentations/Wednesday/Coyote-B-E/PM/Yes/0135%20P%20Booth.pdf

Screenshot:



(site selection to minimize impacts to ecosystem services)

Metric or other outputs:

- Maps showing relative ranking of species richness and protection status, habitat quality/vulnerability, wildlife corridors, vegetation cover types
- A map of a combined biodiversity score
- Unknown outputs of flood control, pollution sequestration, carbon sequestration, and recreation/aesthetics

Questions it can answer:

- Choosing a site to minimize impacts on biodiversity

ECOMetrix

What it does: A field site tool collecting presence/status of ecosystem services, ECOMetrix is intended to be used once a broader landscape-level assessment has identified the parcels where ecosystem services are least likely to be affected. It helps define an approach to design that minimizes impact. At a project site level, maps of scores of ecological functions and ecosystem services. "An environmental measurement and modeling tool that supports sustainable infrastructure, restoration projects, and enterprise-level program decision-making. EcoMetrix models and quantifies changes within an ecosystem, enabling users to evaluate the positive or negative effects of different scenarios and alternative designs on ecosystem services."

Tool Highlight: field tool, measures relative changes of ecosystem services at the site level

Developers: Parametrix

Year: 2010

Time Investment: 15-60 minutes per acre

Link: http://www.ecometrixsolutions.com/

Screenshot:

Figure 13. Ecosystem Services Performance for Area 6

Pilot Results *(expressed in percent ecosystem service performance)*

EcoMetrix Scores for Performance of the Ecosystem Services Selected for the Pilot Study

Area 6	Water Provisioning Service	Climate Regulation Service	Biodiversity Support Service
Baseline Ecosystem Services Performance	52%	36%	33%
Alternative Scenario Ecosystem Services Performance	55%	43%	43%
Change in Performance	+3%	+7%	+10%

Source: http://www.parametrix.com/cap/nat/Example%20report_redacted.pdf

Metric outputs:

- "Functional acre" or "ecosystem services acre" which is described as a percentage measure of optimal performance
- Set of GIS shapefiles that depict the baseline and potential future design (alternative) map unit characteristics, and a spreadsheet that contains the data and scores for each map unit and for the overall site

Questions it can answer:

- Relative performance of different ecosystem services under multiple alternatives
- Alternatives analyses, stakeholder processes, impact analyses, mitigation design, understanding cumulative effects

ENVISION Model

What it does: This is primarily a land use planning tool and is not specifically geared for ecosystem services. "ENVISION is a GIS-based tool for scenario-based community and regional planning and environmental assessments... [it uses] models of ecological, social and economic services to simulate land use change and provide decision-makers, planners, and the public with information about resulting effects on indices of valued products of the landscape"

Tool Highlight: land use planning

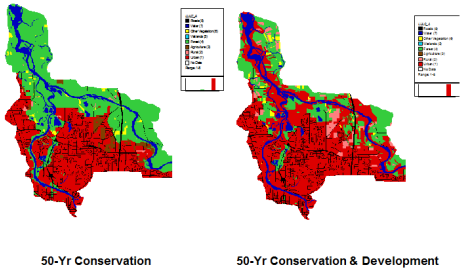
Developers: Oregon State University

Year: Unknown, circa 2008

Time Investment: Unkonwn

Link: http://envision.bioe.orst.edu/

Screenshot:



Metric or other outputs:

- Maps of different land use development/ conservation scenarios

Questions it can answer:

- Envision growth and development scenarios – in relation to ecosystems and/or ecosystem change scenarios (e.g. climate change)

ESValue

What it does: Runs a series of alternative land use/management to show changes in ecosystem services. "A strategic decision support tool that integrates scientific and economic information to show the impact and value of alternative environmental management strategies on ecosystem services. The objective of the tool is to integrate existing information and expert opinion with stakeholder values to efficiently and effectively identify the key site-specific ecological effects and resulting change in economic value for different management strategies." "The tool has two primary components: (1) Ecological effects model – based on scientific understanding of how the proposed management actions would affect ecosystem services and (2) Ecosystem service valuation model – shows the relative value of ecosystem services to stakeholders. Results from these two components are integrated within a spreadsheet model to estimate thhe effect of development on the value of ecosystem services. This analysis provides an overall relative 'score' for each option, which can be mapped to display spatial distribution of results."

Tool Highlight: integrates stakeholder preferences

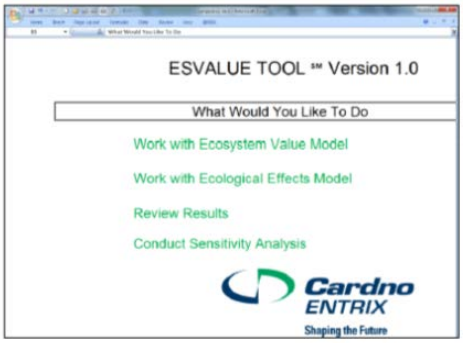
Developers: Cardno ENTRIX

Year: Unknown

Time Investment: 240 hours

Link: No information available from Cardno ENTRIX , but tool is described in http://www.bsr.org/reports/BSR_ESTM_WG_Comp_ES_Tools_Synthesis-SUPPLEMENTARY_MATERIALS_FINAL.pdf, and http://unwqmonitoringonsiteww.wikispaces.com/file/view/UNRBA_Cardno+ENTRIX+Technical+Proposal_FINAL.pdf

Screenshot:



Metric or other outputs:

- Excel spreadsheets of economic value and ecological relationships
- Sensitivity analysis graphs certainty of results and drivers of uncertainty

Questions it can answer:

- Measures relative ecological value of each key ecosystem service
- Identify development locations that would minimize impact on ecosystem services important to stakeholders
- Evaluating alternatives of project variables such as size, siting, and resource use
- Identifying mitigation priorities
- Determining additional ecological data and community outreach needs

InVEST - Integrated Valuation of Ecosystem Services and Tradeoffs

What it does: Designed to run with different scenarios of Land Use Land Cover (LULC) data and show you changes in flows of ecosystem services. "InVEST is designed to help local, regional, and national decision-makers incorporate ecosystem services into a range of policy and planning contexts for terrestrial, freshwater, and marine ecosystems, including spatial planning, strategic environmental assessments, and environmental impact assessments. InVEST models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ecosystem services. The models account for both service supply (e.g., living habitats as buffers for storm waves) and the location and activities of people who benefit from services e.g., location of people and infrastructure potentially affected by coastal storms)."

Tool Highlight: well-respected, multiple modules

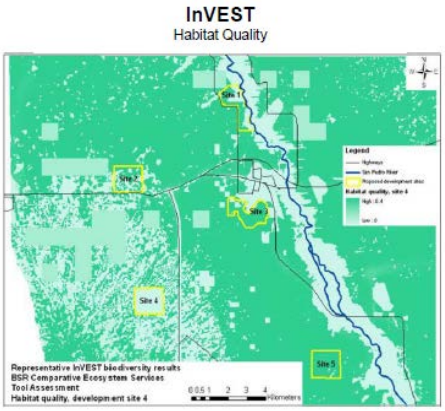
Developers: The Natural Capital Project, including: Stanford University (United States), University of Minnesota, WWF (World Wildlife Fund), The Nature Conservancy

Year: 2011 (v 2.1)

Time Investment: four weeks / 160 hours

Link: www.naturalcapitalproject.org/, http://www.naturalcapitalproject.org/StanfordTrainingFeb2012.html [also see journal article comparing InVEST and ARIES: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2990460/]

Screenshot:



Metric or other outputs:

- Explicit maps of ecosystem services supply, use, and value and associated tables reporting outputs in biophysical and economic units
- Dollar values of ecosystem services
- CO2 sequestered (tons)
- Water yield and evapotranspiration for each sub-watershed
- Water consumption, calibrated supply and realized supply (supply-consumption) as distributed over a watershed landscape
- Amount and value of energy that can be generated at a hydropower plant
- Nutrient retention: amount of nutrient runoff that is retained by the landscape and the amount exported to the stream
- Value of nutrient retention
- Sediment retention: amount of sediment retained by the landscape and amount exported to the stream
- Value of sediment retention (of keeping sediment out of a reservoir to maintain water quality and avoid dredging costs)
- Habitat quality and rarity maps
- Avoided coastal erosion in nearshore regions
- Coastal vulnerability index map
- Grid map of relative index of recreational visitation (proportional visitation rate - % of total visitor-days)
- Map of abundance of pollinators
- Pollinator service value
- Total net present value of timber production (dollar value), map of dollar per unit area
- Total biomass of harvested wood removed (Mg)
- Total volume of harvested wood removed (m3)

Questions it can answer:

- How does a proposed land management plan affect [timber or crop] yields, biodiversity, water quality, and recreation?
- Which parts of a watershed provide the greatest carbon sequestration, biodiversity, and tourism values?
- Where would reforestation achieve the greatest downstream water quality benefits?
- How would agricultural expansion affect a downstream city's drinking water supply? How will climate change and population growth impact these effects?
- Hydropower model: How much water is available? Where does the water come from? How much energy does it produce? How much is it worth?
- Nutrient retention model: Where are the pollutant sources? Where are the pollutant retention areas? How much is retained? What is the value of this retention?
- Sediment retention model: Where are the sediment sources? Where are the sediment retention areas? How much is retained? What is the value of this retention?
- Coastal vulnerability model: Are there areas that are more exposed to impacts of high waves and winds than others? Are there natural factors that can reduce these impacts?

MIMES (Multi-scale Integrated Models of Ecosystem Services)

What it does: "The Multi-scale Integrated Models of Ecosystem Services (MIMES) is a suite of models for land use change and marine spatial planning decision making. The models quantify the effects of land and sea use change on ecosystem services and can be run at global, regional, and local levels. The MIMES use input data from GIS sources, time series, etc. to simulate ecosystem components at under different scenarios defined by stakeholder input. These simulations can help stakeholders evaluate how development, management and land/sea use decisions will affect natural, human and built capital." "MIMES uses the Simile visual modeling environment, allowing users to draw the elements of their models, and the relationships between them." [see inset graphic at right]

Tool Highlight: Dollar value of ecosystem services, uses visual modeling [see inset graphic at right]

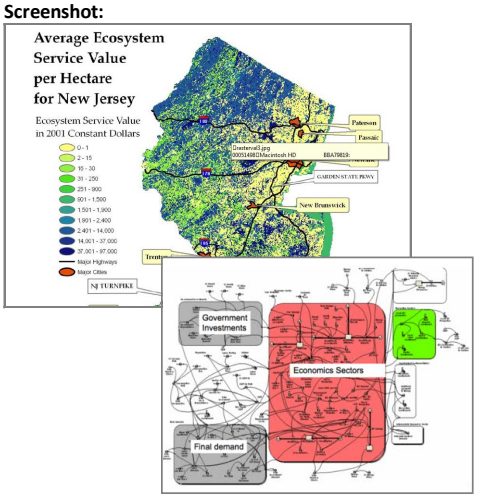
Developers: Gund Institute for Ecological Economics at The University of Vermont "in collaboration with a large international group of scientists and resources managers"

Year: Unknown, circa 2009

Time Investment: Unknown

Link: permanent link no longer on Gund Institute website, but information available at:
http://www.ebmtools.org/mimes.html
http://www.afordablefutures.com/services/mimes

Screenshot:



Metric outputs:
- Dollar values, broken down by land use / land cover type (e.g., forested wetland, cropland, open freshwater)
- Dollar values in different land use scenarios
- Maps of values on the landscape

Questions it can answer:
- [An understanding of the] dynamics of ecosystem services
- How are ecosystem services linked to human welfare?
- How might the value of ecosystem services change under various management scenarios?

NAIS - Natural Assets Information Systems

What it does: "The Natural Assets™ Information System (NAIS) was developed by Spatial Informatics Group (SIG) to estimate Ecosystem Service Values (ESV) using "state of the art" value transfer methods and geospatial science. Value transfer involves the adaptation of existing [peer-reviewed literature] valuation information to new policy contexts where valuation data is absent or limited. For ESVs, this involves searching the literature for valuation studies on ecosystem services associated with ecological resource types (e.g., forests, wetlands, etc.) present at the policy site. Value estimates are then transferred from the original study site to the policy site based on the similarity of ecological resources at the policy site."

Tool Highlight: Applies dollar values for ecosystem services by land use type

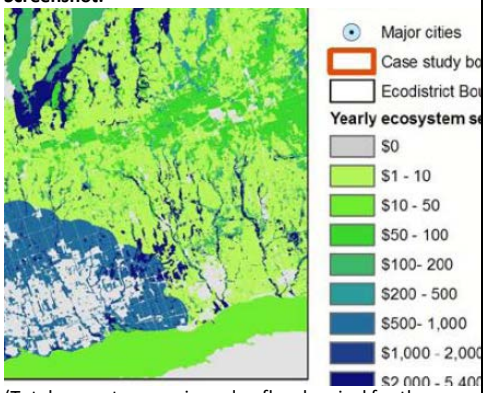
Developers: Spatial Informatics Group

Year: 2009

Time Investment: Unknown

Link: www.sig-gis.com/pg-services-eco.php

Screenshot:



(Total ecosystem service value flow by pixel for the entire study area)

Source:
http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@lueps/documents/document/279512.pdf

Metric outputs:
- Valuation summary table cross-tabulating ecosystem service value flow by land cover and ecosystem service type
- Gap analysis table cross-tabulating number of valuation studies by land cover and ecosystem service type
- Detailed valuation report giving high, low and mean valuation estimates listed hierarchically by study, ecosystem service type and land cover type map of land cover typology
- Map of ecosystem service values by geographic summary units (e.g. watershed, parcel)
- Maps and tables giving outputs under alternative scenarios (optional)

Questions it can answer:
- Dollar value of ecosystem services across a landscape

NatureServe Vista

What it does: This is primarily a land use planning tool and is not specifically geared for 'ecosystem services' but rather user-defined conservation values (which could be defined as areas provisioning services). The official description is "NatureServe Vista enables you to create, evaluate, implement, and monitor land use and resource management plans within the existing economic, social, and political context. It does this by integrating conservation information, natural resource management practices, and land use patterns and policies into a single decision-support system."

Tool Highlight: land use planning

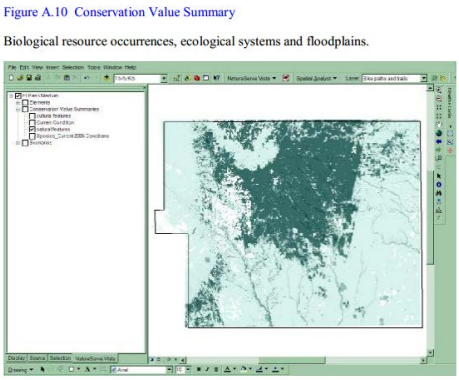
Developers: NatureServe

Year: v2.5 was released in 2009

Time Investment: Unknown

Link: http://www.natureserve.org/prodServices/vista/overview.jsp

Screenshot:



Metric or other outputs:

- Maps of different land use scenarios
- Map of 'conservation value' like threatened and endangered species habitat, ecological systems and floodplains
- Maps of potential conflict zones between development/operations and conservation value

Questions it can answer:

- Assessing land use scenarios, along with alternatives and mitigation development
- Identifying priority areas for conservation

Wildlife Habitat Benefits Estimation Toolkit

What it does: This is a simple, excel-based tool that allows for quick estimates of the non-market value of habitat - for example, wetland and wildlife viewing values, recreational values for fishing and hunting, and property premiums for lands adjacent to open spaces. This tool could provide quick estimates of the value of ecosystem services. Not covered by BSR's review.

Tool Highlight: Simple excel spreadsheet gives dollar figures for ecosystem services

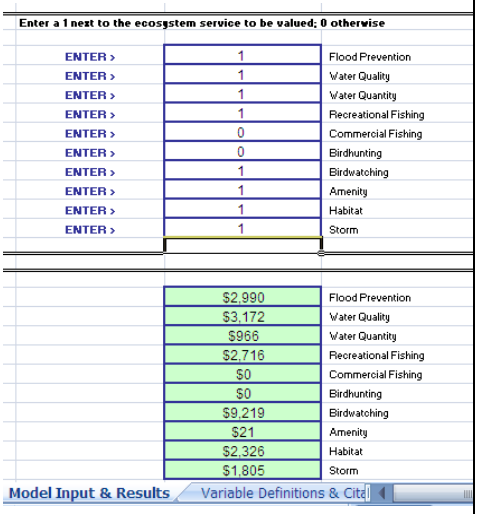
Developers: Defenders of Wildlife

Year: 2008

Time Investment: Unknown, but minimal

Link: http://www.defenders.org/programs_and_policy/science_and_economics/conservation_economics/valuation/benefits_toolkit.php

Screenshot:



Metric outputs:

- Spreadsheet of dollar values of ecosystem services

Questions it can answer:

- Dollar value of ecosystem services based on acreage and absence/presence of services

Tracking Tools

Tools to aid in measuring current levels of ecosystem services and changes over time.

Global Reporting Initiative (GRI)

GRI Sustainability Reporting Framework provides a standardized format and set of indicators that organizations can use to measure and report their economic, environmental, and social performance. Ecosystem services could be readily inserted into the following guidance components: (1) materiality, (2) sustainability context, (3) organizational profile and strategy, and (4) performance indicators.*

Existing Indicators

- Percentage and total volume of water recycled and reused (EN 10)
- Total water withdrawal by source (EN8)
- Water sources significantly affected by withdrawal of water (EN9)
- Habitats protected or restored (EN13)
- Strategies, current actions, and future plans for managing impacts on biodiversity (EN 14)
- Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff (EN25)
- Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation (EN26)
- Energy saved due to conservation and efficiency improvements (EN5)
- Total direct and indirect greenhouse gas emissions by weight (EN 16)

'Possible Future Reporting Indicators'

- Area of production site set aside to protect stocks of natural resources
- Number of production sites under sustainable management (e.g. related to water, maintenance of soil fertility or pollinating species, flood protection)
- Economic cost of artificial pollination services within operation areas
- Adoption of credible, internationally recognized responsible production standards

ISO 14001 Standard

Developed by the International Organization for Standardization, the **ISO14001** standard provides certifiable guidelines specifying the requirements of an environmental management system. Ecosystem services could be readily inserted into the following guidance components: (1) environmental policy, (2) aspects review, (3) objectives and targets, and (4) management review.*

Examples of Integrating Ecosystem Services into ISO 14001*

- Eskom's ISO 14001-conforming Corporate Land and Biodiversity Position ensures that planning and execution of all activities "limit the impact of infrastructure, land use, and other resources on biodiversity and ecosystem services."
- In 2008, The Walt Disney Company set an objective of having a net-positive impact on ecosystems. In order to achieve this objective, the company set near-term targets to develop and implement an integrated approach to design, engineering, and habitat protection for all new construction projects; and to increase the level of support from the Disney Worldwide Conservation Fund over 5 years.
- Natura Cosmeticos interviewed biodiversity stakeholders in 2008 to develop a list of biodiversity and ecosystem service-related aspects material to the company. This led to development of the "Natura Policy for Sustainable Use of Biodiversity and Associated Traditional Knowledge" released in 2010.
- Members of Nissan's global management team conducted a high-level review of the company's dependence and impact on ecosystem services. The process heightened Nissan's attention to future water scarcity issues and enabled the company to institutionalize routine water risk assessments at facilities.

Examples of Corporate Indicators

SAB Miller (source: TEEB for Business)

- Water to beer ratio
- Percent of water from municipal, surface, and ground water

Rio Tinto (source: TEEB for Business)

- Percent of sites with very high, high, moderate, or low biodiversity values
- Number of species of conservation signification with habitats or life cycle dependency on areas within the life holding (also a GRI indicator - EN15)

Puma (source: Puma's 2010 Annual Report)

- Kilotonnes of CO_2e
- Cubic meters of water used
- Biodiversity indicators: narrative report on tannery suppliers complying with [best industry standard], narrative explanation of internal policy to avoid paper sourcing from suppliers harvesting from virgin forests *(These are in the process of being adopted)*

*Source: WRI's Feb 2012 Report "Nature in Performance: Initial Recommendations for Integrating Ecosystem Services into Business Performance Systems,"GRI's 2011 Report "Approach for reporting on ecosystem services"

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