Comments received from Rick Durbrow, EPA Region 4, April 2, 2007

Southeastern Ecological Framework Project (EPA Region 4)

The Southeastern Ecological Framework (SEF) project represents a unique regional approach for the identification of important ecological resources that support ecosystem function across the southeastern United States. This region is one of the fastest growing regions in the US. Despite this, it still harbors a significant amount of globally important biodiversity and other natural resources. The SEF is designed to proactively support Region 4's ability to protect and restore ecosystems under EPA's Strategic Goal of Heathy Communitites and Ecosystems. The ultimate SEF project goal is to ensure that local decision makers are able to balance economic growth considerations with the benefits that functional ecosystems are able to provide through ecosystem services. The SEF also provides a scientific basis for enhancing regional planning across political jurisdictions and to help focus federal resources to support state and local protection of ecologically important lands. The work was completed by the Planning and Analysis Branch of EPA Region 4 and the University of Florida in December of 2001. A second iteration of the SEF is currently under development using the recently completed National Land Cover Data.

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The SEF applied a regional landscape analysis approach that represents ecological services based on functioning ecosystem connectivity across the region in order to sustain critical ecological and biological functions in the region, This approach builds from existing conservation areas and adds additional un-fragmented areas and connecting corridors in order to secure and sustain the protection of ecological function identified through biodiversity as a suragate for ecological services as a function of landscape characteristics. The ecosystem functionality is determined from variables that characterize habitat type, protected areas and presence of rare species. The methodology is designed to meet standards of transparency and repeatability, and can be updated with new data. The GIS decision support approach provides a means to integrate complex data at a landscape scale to aid decision-making.

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This framework has been developed for the eight southeastern states in EPA Region 4 (FL, GA, SC, NC, AL, MS, TN, and KY). This project has created a new regional map of priority natural areas and connecting corridors, along with geographic

information system (GIS) tools and spatial datasets. The framework identified 43% of the land that could be protected and is appropriate for managing for specific societal or ecosystem service benefits. Two additional applications of the SEF were developed to demonstrate its utility for conservation planning at the sub-regional and local scales. This approach is now being evaluated for utility in other regions and nationally.

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The SEF differs from the prior two case studies (Chicago Wilderness and Portland) because it focuses on a broad regional analysis, eight states, rather than a single metropolitan area or watersheds within a metropolitan area. The SEF also differs in that it focuses almost exclusively on using habitat and biodiversity as place holders for ecosystem function and the services provided, since the tools to conduct a broad ecosystem service analysis is not readily available at a regional landscape scale. It also does not attempt to combine economic analysis with ecological analysis to value the protection of ecosystems or services in monetary terms, but uses one as a function of the other. If the system is not fragmented, then the air, water and land benefits associated with the ecosystem are in tact and providing the ecosystem services one would expect. Discussion of values focuses on "conservation value," which is the ability to sustain species and ecological processes.

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Landscape Level Analysis of Ecosystems and Services

Species Conservation and Ecological Systems Conservation. Methods developed by NatureServe for identification and prioritization of conservation actions through spatial representation and analysis of biodiversity and conservation values have been applied across multiple scales and geographies. The Southeastern Ecological Framework shares a number of similarities with these methods. The application of the method results in spatial representation of the uniqueness and irreplaceability of biological and ecological diversity in a regional context. The methods support planning efforts to sustain biodiversity, ecological integrity and ecological services to identify best opportunities to meet stakeholder goals. The approach is based on principles of conservation science, strives for complete transparency, and can provide solutions that reflect different stakeholder values.

The key steps in applying the method are as follows:

Involve stakeholder to identify the biological, ecological and ecosystem service.
Define standards that represent a viable occurrence for each target, and for valuing the relative quality of each of these occurrences.

Define standards for measuring the conservation status of each target.

Create a “conservation value layer” for each target that represents the conservation status of the element and the viability/service value of each occurrence.

Create a “conservation value summary” that represents the composite values of all conservation targets.

Map current land uses, policies, threats, economic values, and compatibilities across the project landscape.

Analyze spatial solutions that address stakeholder goals and provide a clear delineation of priority actions.

Chicago Wilderness has generally used the approach described above to identify biodiversity and conservation values. The conservation targets that the Chicago Wilderness has identified are described in detail in its Biodiversity Recovery Plan.

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Water Quality and Quantity. Water quality and quantity figure prominently in many ecological processes and in the provision of many ecosystem services. Text Box 8 describes possible ecological impacts and impacts on the provision of ecosystem services that are possible from the protection or restoration of watersheds. In some instances, Chicago Wilderness and its member organization have conducted prior studies making it possible to identify site-specific ecological characteristics important to considerations of

Periodicity of flows—changes in the hydrograph are mitigated because precipitation will be captured in the soil and vegetation, and subsequently released more slowly

Maintenance of minimum flows—there is a greater chance of maintaining adequate minimum flows because of the dampening effects of intact watersheds and continuation of subsurface flows.

• Flooding—flooding in reduced because of the retention capabilities of the intact watershed <u>Subsurface water</u>

Availability for domestic and industrial use—will be increased because percolation and subsurface recharge will be enhance by natural soil surface and vegetation

• Maintenance of wetlands—those habitats that depend on the water table or subsurface flow will be enhanced because natural percolation and recharge processes will be maintained

<u>Biological systems that depend upon water quantity</u>

Special status species—increased persistence of those habitats that depend on increased quantities of water in the watershed and containing protected species

• Specific habitats—increased water quantity and more uniform stream flows will support regionally important ecological communities, e.g., in-stream communities, bottomland forests, wetlands and wet prairies

<u>Effect on water quality</u>

Pollution dilution—increased flows will dilute concentrations of organic and inorganic pollutants

Assimilation of biotic pollutants—increased stream flows will permit greater opportunity for the assimilation of biological materials

For simplicity, suppose that both stakeholders and experts decided that the most important ecological services to be used in comparing watersheds within the county were:

a) minimizing flooding, b) maintaining or increasing groundwater recharge, and c) maintaining or increasing wetland communities.

Minimize flooding: The GIS database collected by Chicago Wilderness includes layers depicting rivers, streams, wetlands, forest lands, and floodplains. As a first approximation, historical records of flooding in McHenry County watersheds could be examined. Those watersheds with the greatest flooding could be identified. The analysis could then evaluate the potential for restoring floodplain forests and wetlands for mitigating flooding.

Maintain or increase groundwater recharge: The GIS database includes maps of aquifers and soils maps that described run-off and percolation rates for each soil type. Watersheds could be compared in terms of potential for aquifer recharge. The analysis could then consider the effects of alternative land use decisions on recharge (Arnold and Friedel, 2000).

Maintain or increase wetland communities: Using topographic maps and GIS data on rivers, streams, floodplains, forests, wetlands and land cover, watersheds within McHenry County could be ranked in terms of potential wetlands minus current wetlands. The areas within watersheds with the potential for expanding existing wetlands or restoring wetlands could be measured.

There are a number of GIS data files available from McHenry County that can assist understanding how protecting a given part of a watershed contributes to ecosystem processes and services What is often lacking, however, is a cause and effect relationship that can be used to predict how provision of an ecosystem services will change with changes in management or policy. It may be possible to transfer results from studies of ecological services from other regions. For example, Guo et al. (2000) measured the water flow regulation provided by various forest habitats in a Chinese watershed. If these relationships are transferable, then estimates of the effect of a policy of restoring forest habitat on water flow could be generated. Changes in water flow could then be used to predict impacts on aquatic organisms including game fish production, on wetland and their consequent production functions such as waterfowl, fisheries, wildlife viewing, etc. (Kremen, 2005).

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1 To invest the $50 million approved by voters for watershed protection in 2 McHenry County in a way that will maximize the value of protecting ecosystems and 3 services, a decision-maker needs to know more than just how protecting a given part of a 4 watershed contributes to ecosystem processes and services. When there are tradeoffs 5 among different services, protection versus improvements in water quality for example, 6 then information about the value of flood control versus the value of improved water 7 quality is necessary to know whether certain tradeoffs are worthwhile or not. This 8 requires information beyond just understanding the ecological impacts of management 9 and policy alternatives.

Valuation of Changes in Ecosystems and Services in Monetary and Non Monetary Terms

The Role of Valuation. The primary goal of Chicago Wilderness "is to protect the natural communities of the Chicago region and to restore them to long-term viability." Given this goal, it may be argued that monetary valuation is of secondary importance and of primary importance is to understand how various potential strategies contribute to the protection and restoration of natural communities, or to the provision of ecosystem services. Chicago Wilderness has, in fact, devoted most of its attention to biophysical measures of the status of natural communities and much less attention to measures of value, monetary or otherwise.

With a clearly stated single biological objective, such as "to protect natural communities," economic analysis may be restricted to estimating the cost of various potential strategies to achieve that objective. Combining information about how various potential strategies contribute to the protection and restoration of natural communities along with information about the cost of these strategies is all the information necessary for cost-effectiveness analysis. Cost-effectiveness analysis addresses the issue of how best to pursue an objective given a budget constraint. In cost-effectiveness analysis, there is no need to estimate the value of protecting natural communities or of ecosystem services.

However, when there are multiple natural communities of interest, or multiple ecosystem services of interest, it becomes important to address questions of value. Is it more valuable to allocate more of budget to restoring upland forest or wetlands? Is it

more valuable to mitigate flood risk or improve water quality? Such questions can only be addressed by comparing the relative value attached of different natural communities or services.

Monetary valuation of the protection of natural communities may be important for Chicago Wilderness, and more broadly to society at large, for several reasons. First, when there are multiple sources of value generated by protecting natural communities (e.g., species conservation, water quality, flood control, recreational opportunities, aesthetics, etc), monetary valuation provides a way to establish the relative importance of various sources of value. With "prices" or "values" attached to different ecosystem services, one can compare alternatives on the basis of the overall value generated. Second, some biological concepts such as "biodiversity" are multi-faceted. How one makes tradeoffs between different facets of biodiversity conservation, or among protection of different natural community types, is the ultimately the same question as how one makes tradeoffs among multiple objectives. Again, establishing prices on different components of biodiversity or on different natural communities allows for analysis of tradeoffs between components and an assessment of the overall value of alternatives. Finally, monetary valuation may facilitate communication about the importance of protecting and restoring natural communities in terms more readily understood by the general public.

Value may also be addressed using non-monetary valuation. If what is needed is to assess tradeoffs between protection of different natural communities or among different services, this may be done most directly by making such comparisons without the additional complication of trying to convert these values into monetary terms. In other words, it may be far easier for people to answer questions about whether they think it more important to provide additional protection of forests versus wetlands, as compared to asking about the monetary valuation of forest protection and the monetary valuation of wetland protection.

Valuation of Species Conservation and Ecological Systems Conservation. Protecting natural communities may be done for reasons related to the provision of ecosystem services, or it may be done just because people value intact natural communities (e.g., existence value or intrinsic value). The only methods currently

accepted by economists for estimating non-use values, such as the existence value of natural communities or biodiversity, are stated preference methods: contingent valuation (CVM) and conjoint analysis. In trying to estimate the value of protecting species and ecological systems, Chicago Wilderness could survey respondents in the Chicago area using CVM or conjoint analysis. Alternatively, Chicago Wilderness could attempt to use a benefits transfer approach by applying the results of relevant surveys done in other locations. The advantage of obtaining a monetary value for the conservation of species and ecological systems through CVM or conjoint analysis is that it would allow Chicago Wilderness to calculate a total economic value for alternative strategies. Without using CVM or conjoint analysis, Chicago Wilderness could not include non-use values and would be able to estimate a partial economic value for each strategy. (CVM is very expensive and most local community decision makers are not going to be waiting for the results of a survey that they can not affort. It also requires that the decision maker accept the same values that are being expressed from the community, which is not viewing the political context of the actual decision being made.)

Critics of stated preference approaches have raised a number of concerns regarding its accuracy and reliability. (These are adcademic critics and not local county officials who tend to see CVM as fantasy or conjecture and not the actual value of one development approach over another. It is not whether the survey tool was accurate, it's that there is no monetary value that they can put there hands. There is an imaginary value, but not one that somebody has actually given to support the government services that the county officials are trying to balance.)Concerns have focused on whether respondents provide accurate values of the specific question at hand or instead are expressing a general preference for protecting nature, whether some respondents engage in strategic or protest answers, and whether respondents recognize income constraints in their answers. Survey techniques have improved considerably, reducing many of these concerns, but controversy over the reliability of stated preference method still exists. There also is an unresolved dispute whether CVM studies should ask for willingness-to-pay (lower and perhaps more reliable answers) or willingness-to-accept (higher answers that may better reflect the initial legal rights but are thought to be unreliable).

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Any effort to place a monetary value on non-use values through stated preference methods raises the questions of whether monetary values are commensurate with the types of values that Chicago residents attach to protecting natural communities. In discussing the importance of protecting biodiversity, Chicago Wilderness emphasizes that a survey of public attitudes regarding biodiversity involving Chicago focus groups found that "responsibility to future generations and a belief that nature is God's creation were the two most common reasons people cited for caring about conservation of biodiversity." (Biodiversity Recovery Plan, p. 14.) CVM valuation of the bequest value of biodiversity might be consistent with measuring "responsibility to future generations," although the respondents in the focus group were presumably thinking in moral rather

than monetary terms. Strong differences of opinion exist on whether it is appropriate to try to capture such notions as “stewardship” or “moral values” in monetary terms using stated preference methods.

Deliberative valuation exercises using citizen juries or other small focal groups might be a particularly useful means of evaluating tradeoffs among potential strategies to protect natural communities in the Chicago Wilderness context. Under deliberative valuation, experts would work with a small group of selected individuals in the Chicago area to determine comparative values for parcels of land through a guided process of reasoned discourse. Deliberative valuation might enable participants to develop more thoughtful and informed valuations, to better tradeoff among multiple factors, and to engage in a more public-based consideration of values. Experts could use deliberative valuation either to try to come up with monetary comparisons of the values of the alternative properties or with weights that could be used to aggregate multiple layers of data.

Monetary values derived through deliberative valuations may differ considerably from traditional private values, both because of the consent-based choice rules that deliberative valuation employs and the explicitly public-regarded nature of the valuation exercise. Recent analysis suggests that deliberative valuations may aggregate individual values in a manner that systematically departs from the additive aggregation procedures of standard cost-benefit analysis. (Howarth & Wilson, 2006.)

Valuation of Water Quality and Quantity. Changes in water quantity can be valued either because there is too much (flood control) or too little water (water availability). (In my experience with local officals, this is the area that they need more information. They want to be able to way the tax benefit from a new development with the costs to replace the loss of flood control that the land was providing.)

Flood control: approach is to measure avoided damages with reduction in probabilities of flooding. Studies of the value of preserving wetlands for flood control have been undertaken in Illinois: Salt Creek Greenway in Illinois (Illinois Department of Conservation, 1993; USACE, 1978) and in Cook County where the estimated value of

regional floodwater storage was $52,340 per acre (Forest Preserve District of Cook County Illinois, 1988).

Water availability: another important ecosystem service in many metropolitan areas is to provide clean drinking water. One of the more famous examples of the value

of ecosystem services is the case of the provision of clean drinking water from watersheds in the Catskills for New York City (NRC 2000, Chichilnisky and Heal 1998). There is also value of surface recharge of aquifers (NRC 1997).

Valuation of Recreation and Amenities. A large literature in environmental economics exists on estimating the values of various forms of recreational opportunities and amenities created by the natural environment. Typical methods used by economists to estimate the monetary value of recreation and amenities include hedonic property price analysis, travel cost, and stated preference. In addition, there is a smaller literature that uses evidence from referenda voting to infer values for open space and other environmental amenities.

There is a large empirical literature that estimates the value of environmental amenities on the value of residential property value using the hedonic property price model. (This approach is also accepted at the local level, because they can see the property tax increase based on a decision to protect open/green space. The hedonic property price model has been applied to estimate the value of air quality improvements (e.g., Ridker and Smith 1967, Smith and Huang 1995) living close to urban parks (e.g., Kitchen and Hendon 1967, Weicher and Zeibst 1973, Hammer et al. 1974), urban wetlands (Doss and Taff 1996, Mahan et al. 2000), water resources (e.g., Leggett and Bockstael 2000), urban forests (e.g., Tyrvainen and Miettinen 2000), and general environmental amenities (e.g., Smith 1978, Palmquist 1992). Given the large number of residential property sales in the Chicago area in any given time period, and large data bases on attributes of the property, there is great potential for Chicago Wilderness to utilize such studies to estimate values of various environmental amenities. This method has not been used by Chicago Wilderness to date.

A large literature also exists on the value of recreation sites using the travel cost method. Given the large number of visitors to Lake Michigan beaches, forest preserves, and parks in the Chicago metropolitan area, there is great potential for Chicago Wilderness to apply travel cost to estimate the value of recreational activities. To date, these methods have not been applied by Chicago Wilderness. {Provide references on appropriate travel cost studies in an urban setting} (I have also seen some acceptance for this approach, but typically not as helpful to their land use discussions.)

Stated preference methods can also be used to estimate the value of recreational opportunities and environmental amenities. One such study has been done for Chicago

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1 Wilderness. Kosobud (1998) estimated the willingness-to-pay for “wilderness recovery 2 and extension activities” in Chicago region. {Provide short summary of results} 3 Finally, there is a small but growing literature that analyzes the results of voting 4 behavior in referenda involving environmental issues to estimate values. In particular, 5 studies have analyzed the value of open space using results of voting on open space 6 referenda (Kline and Wichelns 1994, Romero and Lissero 2002, Vossler et al. 2003, 7 Vossler and Kerkvliet 2003, Schläpfer and Hanley 2003, Schläpfer et al. 2004, Howell8 Moroney 2004a, 2004b, Solecki et al. 2004, Kotchen and Powers 2006, Nelson et al. 9 2007). As noted above, several counties in the Chicago metropolitan area have passed 10 referenda authorizing bonds to purchase open space or for watershed protection. Though 11 the number of referenda is relatively small, making it difficult to generalize or make 12 comprehensive statements about values, analysis of the results of these referenda could 13 provide insights into the values of different segments of the public for various 14 environmental amenities..

15 **7.5. Summary** 16 A number of methods exist that could be applied by Chicago Wilderness to assess 17 the relative value of alternative strategies to protect ecosystems and services. Application 18 of these methods would generate information that could be of great use to decision19 makers in evaluating alternative strategies to protect natural communities that would be 20 most beneficial for the public at large. To date, however, Chicago Wilderness has 21 focused almost exclusively on biophysical measures that assess the extent and current 22 condition of natural communities. There have been some attempts to collect information 23 about the value of protecting natural communities and ecosystem services (e.g., Kosobud 24 1998), but this effort has not been comprehensive or systematic. This is mostly due to the 25 mix of expertise of members organizations that make up Chicago Wilderness. Interest 26 exists to include economic and other social science approaches to study the value of 27 protecting natural communities, but there has not been the right mix of available expertise 28 and circumstances to make this a reality.

7.6. Lessons Learned

Regional-scale analysis has great potential to inform decision-makers and the general public about the value of protecting ecosystems and services. Regional-scale partnerships between EPA Regional Offices, local and state governments, regional offices of other federal agencies, environmental non-governmental organizations and private industry could aid both EPA and local/state partners. Such partnerships offer great potential for improving science and management for protecting ecosystems and enhancing the provision of ecosystem services. At present, however, this potential is largely unrealized. To take advantage of this potential, EPA would need to increase the capacity of regional offices in both economic and ecological analysis. EPA would need to devote resources to make the study of the value of protecting ecosystems and services a high priority. Making this a high priority is hampered by the lack of specific legal mandates or authority to study these values. Given tight agency budgets, the valuation of ecosystems and services at present appears to be more of an unaffordable luxury rather than a necessity.

A review of several regional analyses of ecosystems and services yields the following general lessons:

Important ecological processes take place at a regional scale, making it perhaps the most appropriate scale at which to analyze the value of ecosystems and services.

Recent increases in publicly available spatially-explicit data and a parallel expansion in the ability to display and analyze such data make it feasible to undertake comprehensive regional-scale studies of the value of ecosystems and services.

Many important decisions affecting ecosystems and the provision of ecosystem services are taken at a regional scale by municipal, county, regional and state governments but local and state governments rarely have the technical capacity, or the necessary resources, to undertake regional-scale analyses of the value of ecosystems or services, or to

1 incorporate the value of ecosystems or services into their decision-making 2 processes. 3 • Many regional-scale analyses to date have greater ability to characterize 4 current extent and condition of natural habitat types but much more 5 limited ability to analyze likely consequences of changes in policy or 6 management, and very limited ability to measure impacts on the value of 7 protecting ecosystems or services. 8 • Lack of economists and social scientists in EPA regional offices limits the 9 ability of the regional offices to partner with local and state governments 10 in ways that contribute to involving local stakeholders and in conducting 11 valuation studies. In addition, there is a great need to increase the ability 12 of natural scientists to collaborate with economists and other social 13 scientists in doing integrated research at a regional scale.