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## Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies: White Paper

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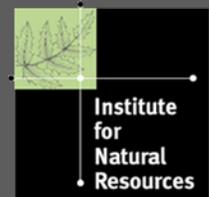
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# White Paper

## Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies



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April 2013

# Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies

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## THE INSTITUTE FOR NATURAL RESOURCES

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*Photo by Jimmy Kagan*

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## **Disclaimer**

The contents of this report reflect the views of the authors who are solely responsible for the facts and accuracy of the material presented.

This report does not constitute a standard, specification, or regulation.

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# Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies

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## Background

The “Integrated Ecological Framework” (IEF) is an ecological assessment process and framework to integrate conservation planning and transportation planning. The nine-step IEF:

1. takes into account the barriers transportation agencies experience when working to implement ecological approaches to transportation planning, and the scientific and technical processes needed to implement ecological approaches;
2. brings together a variety of well-tested methods, data, and tools into a cohesive ecological assessment framework
3. takes into account regulatory assurances for resources regulated under the Clean Water Act and the Endangered Species Act; and
4. provides guidance about how transportation agencies could develop and use ecosystem crediting systems and markets.

For each step in the IEF, critical data needs and tools that could greatly facilitate implementation of the Framework were identified. It is a congruent technical framework to the [Eco-Logical](#) approach, developed by eight Federal agencies in 2006, which recommends a collaborative, integrated, watershed or ecosystem scale approach to decision-making during infrastructure planning, environmental review, and permitting.

One of the steps of the IEF is to develop a crediting strategy (Step 6) that is designed to take advantage of what was thought to have been the rapidly emerging development of crediting information and tools. The Ecosystem Services Crediting methodology is the part of the IEF needing the most additional development to make it easily usable and meaningful to transportation agencies, and the focus of this paper is to identify the ways in which this can be most effectively done.

## Ecosystem Services Introduction

The ability to measure and value the services provided by the environment holds great promise for society’s ability to assure these services are maintained over time. In 2008, Congress directed the Secretary of Agriculture to facilitate the development of environmental markets and ensure the participation of America's farmers, ranchers, and forest landowners. USDA established the [Office of Environmental Markets](#) (OEM) to work across government and in consultation with experts and stakeholders to build market-based systems for quantifying, registering, and verifying environmental benefits produced by land management activities.

*Ecosystem Services* are commonly defined as **benefits people obtain from ecosystems**. The [Millennium Ecosystem Assessment](#) (2005), a four-year United Nations assessment of the condition and trends of the world's ecosystems, categorizes ecosystem services as:

- **Provisioning Services** or the provision of food, fresh water, fuel, fiber, and other goods;
- **Regulating Services** such as climate, water, and disease regulation as well as pollination;
- **Supporting Services** such as soil formation and nutrient cycling; and
- **Cultural Services** such as educational, aesthetic, and cultural heritage values as well as recreation and tourism.

As population, income, and consumption levels increase, people are putting greater pressure on the natural environment to deliver these benefits. The Millennium Ecosystem Assessment, prepared by a group of over 1300 international experts, found that 60 percent of ecosystem services assessed globally are either degraded or being used unsustainably. Seventy percent of the regulating and cultural services evaluated in the assessment are in decline. Millennium Ecosystem Assessment scientists predicted that ecosystem degradation could grow significantly worse in the first half of the 21st century, with important consequences to human well-being.

Considering ecosystem service values, costs and benefits is an efficient way to consider both impacts and improvements to the environment, and as such can represent a new way for transportation agencies and regulatory agencies to address unavoidable losses and associated mitigation.

## **Ecosystem Services and Transportation**

Ecosystem services measurement and crediting tools can improve the transportation planning and implementation process in two ways. First and foremost, they improve the process of mitigating environmental impacts by reducing transaction costs, improving environmental outcomes, and shortening the time needed to implement projects. The majority of this white paper provides a discussion of the best way for DOTs and MPOs to take advantage of newly developed or developing methods and tools.

Second, they can benefit transportation agencies by aiding the development of environmental performance measures that can be incorporated throughout the transportation planning process. In this case, environmental performance measures often require the same information needed to measure ecosystem services. There are several examples of work that have been done to design these measures. For example, as a result of the Oregon Department of Transportation's (ODOT) success in using performance measures in their Oregon Transportation Investment Act (OTIA) Bridge Delivery Program (Nell et al. 2005) ODOT was tasked by the state legislature in 2008 to include environmental performance measures in their State Transportation Plan (STIP). The goal was to use more general measures describing environmental outcomes related to projects, to assure they always achieved the most effective avoidance and minimization in the planning and design phases. ODOT is currently finalizing these internally with their senior management team, after which point they will make them available to the general public.

# Ecosystem Services Crediting and Mitigation

Ecosystem service credits are essentially units of environmental benefit. [Credits](#) are created through the conservation or high-quality restoration of naturally functioning ecosystems. They represent the quantification of things ranging from provision of clean water for community drinking supplies, to pollination of agricultural crops, to sequestering carbon to help mitigate climate change. Of these, carbon, water quantity and availability for drinking and irrigation, endangered species and water quality are the closest to having established crediting systems or methodologies available for DOTs and MPOs. Tools for water quality crediting, particularly for nitrogen, phosphorus and temperature, are well along in development; although addressing erosion and stormwater crediting still needs extensive work, and may need to be a priority for transportation research.

Using an ecosystem services approach to mitigation requires two components: 1) methods and protocols to quantify units of environmental benefit (credits) or impact (debits); and 2) a crediting framework in which regulatory agencies and stakeholders agree to a common set of standards and operating procedures that govern how credits and debits can be used to meet mitigation requirements.

Transportation planners should develop a crediting framework or strategy to provide *consistent methods or tools* to measure ecological impacts, restoration benefits, and long-term performance at the project level. By doing this, planners can align mitigation objectives and have greater efficiency and proficiency in identifying mitigation and restoration opportunities that address multiple ecosystem services. Accurately measured project impacts and mitigation site benefits can be more readily converted into credits. Standards and procedures, agreed to *a priori*, can expedite regulatory approval.

When proposed for permitting under the terms of the Clean Water Act (CWA) §404 and Endangered Species Act (ESA) §7 and §10 programs, many transportation, infrastructure, and development projects cannot avoid impacts to wetlands, streams, and the habitat of sensitive species. In these cases, state and regional transportation agencies must work with federal and state regulatory agencies to avoid and minimize adverse impacts to aquatic resources and habitat. Environmental performance measures can assist in assuring this happens.

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*The objective of a crediting system is to create a strategic, analytic approach to compensatory mitigation, resulting in improved environmental outcomes and faster project approvals.*

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While ecosystem services crediting can provide many benefits and opportunities in developing conservation and restoration plans, transportation agencies and MPOs attempting to work through the Integrated Ecological Framework *only need to address the ecosystem services that are protected by current regulations*. Once an MPO or DOT develops or adopts quantification tools and protocols for regulated services, they could choose to implement them for some of the unregulated services.

After impacts to aquatic resources and habitat are avoided and minimized as much as possible, transportation agencies are required to compensate for unavoidable impacts to these resources. Compensation, or compensatory mitigation, is both expensive and time consuming, and often results in sub-optimal environmental outcomes. However, if done correctly, it can be an important method of maintaining healthy, economically valuable ecosystems.

The objective of a crediting system is to create a strategic, analytic approach to compensatory mitigation. It addresses site design and selection, and should include a robust analysis of the suite of data on the watershed/landscape in which the compensatory mitigation project is being proposed. Much of this work has been described in earlier steps of the Integrated Ecological Framework. However, when related to mitigation – whether applied through a mitigation or conservation bank, in-lieu fee program or another compensatory mitigation mechanism – planners whenever possible should seek to characterize a watershed or ecosystem’s functions.

There is often some confusion between *functions* and *ecosystem service values*, and in general the differences do not impact transportation planners very much. However, when dealing with wetlands and streams, the regulatory community has chosen to require both the functions and values to be maintained or replaced (Stokstad 2008). Therefore, in siting and designing compensatory mitigation projects, it is necessary to assure the site will improve the overall condition of a hydrologic or ecological unit, and will provide at least the important functions. In summary, to be effective, these regulatory approaches to compensatory mitigation must at least consider the entire array of multiple ecosystem functions or services which must be addressed under the current regulatory framework.

Many states have or are in the process of developing mitigation programs and programmatic agreements to address wetlands; a few states have been developing similar programs for endangered species. It is also possible to create crediting tools for transportation by working with regulators to develop methods to measure, map and value services such as stormwater improvement, TMDL or 303d nutrient abatement. Trading can lead to programmatic agreements and pre-approved mitigation areas with established credits for multiple credit types.

A set of standard methodologies are needed to enable transportation agencies and MPOs to measure the ecosystem services and functions being lost from project impacts or gained from rehabilitation. At this point, almost all ecosystem crediting work has been done locally or regionally, rarely across a state and almost never across multiple states. It is unclear if the tools and processes developed to measure

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ecosystem services or convert them to credits for specific regional projects would be applicable in or transferable to different geographies. The Office of Environmental Markets (OEM) and others supporting environmental market development are working to create effective tools and methods that can be modified based on different ecosystems, services, and partners.

Some of the groups creating methods and tools, such as Willamette Partnership, are working together with guidance from OEM to share the work and create standardized guidelines for methods and tools. OEM is currently working with partners on a variety of projects. Examples include the Natural Resources Conservation Service's (NRCS) award of Conservation Innovation Grants for market development. These projects will serve as launching-points for regional market development. Last fall, OEM and the Willamette Partnership created a document called "[In it Together](#)," aimed at providing guidance for groups interested in building water quality trading programs across the country. OEM believes that markets support environmental improvement in a cost efficient manner, and working with partners is one approach to create consistent tools and guidance. Transportation agencies or MPOs may benefit by creating tools specific to promoting multiple services mitigation banking and programmatic agreements.

Currently, because of the degree to which existing mitigation has failed to meet conservation objectives, regulatory agencies have identified the need to use a watershed approach for mitigation (Stokstad 2008). The use of landscape measures, conservation priorities, and the evaluation of multiple services and functions can help identify mitigation sites where environmental outcomes will be improved. This should lead to more rapid regulatory approvals and simpler programmatic agreements.

*Information developed for both the crediting system and programmatic agreements are going to be almost identical.*

Developing a regional mitigation strategy can be effective without a crediting protocol. The Maryland Watershed Resource Registry created by the U.S. Environmental Protection Agency and the Army Corps of Engineers in Maryland or Virginia's Wetland Restoration and Mitigation Catalog created by the Virginia Department of Conservation and Recreation both include functional wetland assessments to develop priorities for mitigation sites. Other models from California, Oregon, North Carolina and other states strategically identify priority compensatory mitigation sites, although the Maryland and Virginia methods are the most integrated into the needs of Clean Water Act regulators, regarding both §404 and §401 permitting (Weber and Bulluck 2010; Bryson et al. 2010).

Regardless of federal policy in this area, the tools and methods being developed in leading states can be used across the country; modifying the measures to address different local regulatory drivers is not complicated. For example, in the Pacific Northwest, most TMDLs and water quality issues related to transportation (and public sewage systems and power generation) must focus on water temperature; however, nitrogen and phosphorus pollution are the primary drivers of water quality issues in the Ohio River Basin. Though there may be specific tools required to measure stream shading in the Northwest

that are not needed in the Midwest, the majority of the water quality measuring tools can be modified to work in either geographic location.

The presence of a local set of measurement or crediting tools should not determine if a DOT or MPO attempts to create a crediting system. Rather, if there are significant impacts to wetlands, streams, rivers or endangered species, significant cost-benefits can be obtained by implementing a crediting program. Basically, these programs can be the basis of a programmatic agreement, and information developed for both the crediting system and the programmatic are going to be almost identical.

## USDA's Office of Environmental Markets

USDA's Office of Environmental Markets (OEM) is tasked with establishing uniform guidelines for the development of science-based methods to measure the ecosystem services benefits from conservation and land management activities. OEM also works to facilitate the participation of farmers, ranchers, and forest landowners in environmental markets, which may include water quality trading, species banking, wetlands mitigation, greenhouse gas reductions, and carbon offsets. OEM facilitates environmental market efforts within USDA and across federal agencies in order to quantify environmental benefits and increase conservation.

Much of OEM's work has focused on the development of tools and metrics to quantify ecosystem service benefits. Quantifying these services is a challenging, but necessary, element to environmental markets and serves as the basis for creating units of trade. The Nutrient Tracking Tool (NTT) is one example of a quantification tool that OEM is helping to develop. NTT quantifies on-farm losses of nitrogen, phosphorous, and sediment in waterways as a result of implementing best management practices. NTT can be applied across the country, and the number of watersheds parameterized for the tool is increasing. OEM is also involved in creating recommendations to integrate existing greenhouse gas models, and is developing frameworks to support measurement of biodiversity and ecological integrity outcomes.

OEM also works with partners to create guidance documents and case study examples of market development across the country. In addition to "In it Together," OEM worked with the Willamette Partnership to create "[Measuring Up](#)" in 2011, which outlines ways to standardize systems for measuring outcomes of biodiversity incentive programs and provides options for federal agencies. OEM also partnered with Forest Trends to develop "[Farm of the Future](#)," which profiles working farms, forests, and ranches that are participating in environmental markets or receiving payments for ecosystems services. These guidance documents can serve as useful references as the transportation sector becomes more involved with environmental markets.

Although OEM is involved with markets across the US, the Office is heavily invested in Chesapeake Bay market development, and leads both a USDA working group and an [inter-agency team](#) aimed at facilitating environmental markets in the Bay. These groups coordinate actions and create guidance and infrastructure for market development. One example is the USDA's partnership with the World Resources Institute to develop a platform for interstate water quality trading in the Bay, called

NutrientNet. The platform reduces market transaction costs, standardizes calculations of nonpoint source reductions, and improves public participation and oversight.

OEM also provides training courses, workshops, and outreach to engage stakeholders and build relationships as ecosystem markets continue to develop and grow. They can serve as a resource for information related to ecosystem services crediting in transportation, and should be targeted for engagement in creating guidance for involving the transportation sector in environmental markets on a national scale.

## Examples of Current Use of Ecosystem Services Crediting in Transportation

Active programs to develop crediting for ecosystem services in transportation are underway in California, [Maryland](#), [Minnesota](#), [North Carolina](#), [Ohio](#) and Oregon, and these are discussed individually below. Almost all of these are willing to share methodologies and tools. [The Bay Bank](#) (Chesapeake Bay), [Willamette Partnership](#), [The Natural Capitol Project](#), the [United Nations Environment Program](#), and [Earth Economics](#) all provide guidelines and program implementation examples and guides.

### California

For a number of years, California was the only state with an active climate registry. The California Climate Action Registry was a voluntary organization created to promote early actions to reduce greenhouse gas emissions; the effort ended in 2010. Currently, California has the most extensive endangered species banks and trading systems in the country, many of which are established to meet the requirements of both the US Endangered Species act as well as those of the California Environmental Quality Act (CEQA). The most relevant project for transportation may be the Regional Advance Mitigation Planning (RAMP) and Statewide Advance Mitigation Initiative (SAMI) programs. RAMP is a collaborative multi-agency group charged with developing a statewide strategy for long term conservation. SAMI is also collaborative multi-agency effort to implement advanced project mitigation through the preservation or restoration of acquired lands which meet multiple conservation objectives. These efforts will be achieved through the establishment of mitigation banks, conservation banks, and/or in-lieu fee programs. Memorandums of Understanding have been signed by multi-agencies for collaboration which have fostered the institutional support to work collaboratively internally and externally to develop this initiative.

### Maryland

There are a number of ongoing programs in Maryland, which provide an opportunity to develop a crediting framework, although neither a statewide or regional program has been developed to date. The Chesapeake Bay restoration effort and work by the [Bay Bank](#) provide opportunities for private landowners. Also promising for MDOT and MPOs is the [Watershed Resources Registry](#), a statewide set of prioritized spatial data, compiled by the Army Corps of Engineers and EPA that describe the significance of the different resources (Bryson et al. 2010). Because these data were developed by the regulatory agencies, it is likely they would be accepted as part of a statewide programmatic agreement.

The watershed resources registry does not develop a credit system, but focuses on identifying mitigation and restoration opportunities, needs, and priorities within each watershed in Maryland. Maryland also has created a partnership between MDOT, DNR, Planning, Agriculture and the Governor's Office to create a [Smart, Green and Growing](#) program which outlines state priorities via a [Greenprint](#), along with efforts to restore habitats, address stormwater and other related programs. These pieces are largely the same ones required to provide the first steps of a crediting framework.

## **Minnesota: Wetland Restoration Strategy and Rapid Assessment Method**

Minnesota has several innovative plans, tools, and regulations in place that could support the incorporation of ecosystem service considerations into compensatory mitigation site selection and design. In 2009, several state agencies joined together to release a unified Wetland Restoration Strategy. Ecosystem services values are a central component of the strategy, though the strategy does not provide specific methods to incorporate these values into mitigation site selection.

Minnesota has also completed a Restorable Wetlands Inventory (RWI) in the state's prairie pothole region and uses GIS terrain analysis in the remainder of the state to identify restorable wetlands. The RWI is a collaborative effort between numerous state, federal, and local partners to map drained wetlands based on county soil survey hydric soils data, USDA Farm Service Agency compliance slides, USGS topographic maps, and NWI maps. However, RWI and the state's other efforts to prioritize wetlands for restoration do not explicitly incorporate ecosystem service benefits (MN BWSR 2009).

Minnesota also has a comprehensive freshwater wetland permitting program that explicitly encourages the selection of compensation sites based on landscape-scale consideration of watershed needs and ecosystem functions. Much like the 2008 Federal Compensatory Mitigation Regulations, Minnesota's wetland regulations specify that compensation projects must consider "landscape position, habitat requirements, development and habitat loss trends, sources of watershed impairment, protection and maintenance of upland resources and riparian areas, and provide a suite of functions" (Minnesota Wetland Conservation Act 2010). The regulations also specify upland buffer requirements for all wetland replacement projects. Finally, Minnesota requires that wetland compensation follow detailed siting procedures based on an impact's minor watershed, major watershed, county, bank service area, and metropolitan area; these siting requirements vary based on the percent of pre-settlement wetlands intact in a county/watershed. Minnesota's regulations support selection of higher-quality compensatory wetlands by explicitly requiring consideration of a suite of landscape features that influence wetland function and by promoting offsets that occur in high-needs watersheds or counties (Minnesota Wetland Conservation Act 2010).

In addition to the tools discussed above, Minnesota has in place a state-specific wetland rapid assessment method (MnRAM) that allows for more detailed field-based measures of a wetland's functional and economic value. MnRAM allows regulators to provide subjective ratings of a compensatory wetland's value for ecosystem services such as flood and stormwater storage, downstream water quality protection, shoreline protection, habitat value, and recreational and commercial uses. MnRAM is utilized both in assessing potential wetland compensatory mitigation sites and in subsequent evaluation of mitigation sites for regulatory compliance with performance standards.

The main wetland restoration prioritization tools and methods used in Minnesota (i.e., the Wetland Restoration Strategy and state regulations), however, seek to guide wetland protection and restoration projects to previously drained wetlands and do not specifically institute more detailed consideration of specific ecosystem functions or services that can be evaluated using MnRAM (Fennessy et al., 2004).

## **North Carolina**

[North Carolina](#) has implemented an Ecosystem Enhancement Program (EEP) that is entirely funded by the NC Department of Transportation (NCDOT). The program, part of their Department of Environment and Natural Resources (DENR), works with watershed groups throughout the state to establish restoration and mitigation priorities, creating the equivalent of a statewide programmatic for Clean Water Act issues. This is possible because DENR also administers the state's water quality program. While ESA issues are not an important part of the EEP, the NC Natural Heritage Program which manages the ESA location information for the state is also part of DENR and provides information to the EEP office to assure that state ESA priorities are at least addressed in the restoration priorities. In 2001, NCDOT reported that 55 percent of its transportation developments were delayed by wetland mitigation requirements. After ramping up streamlined transportation planning and mitigation through EEP, there were no delays in Transportation Improvement Projects associated with EEP (Venner 2010).

The EEP program is a partnership between NCDOT and DENR, which works well for stream and river impacts. Using a watershed framework, they equate all of these to a programmatic agreement and address the ecosystem services provided by these streams. The EEP Deputy Director, Michael Ellison, presented at the recent Conference for Ecosystem Services in Florida, and was asked if additional regulated resources, such as wetlands or endangered species, could be included in the EEP. His view was that EEP's existing agreement with NCDOT and the compensatory nature of their agreement made it impossible to address different services. Research into the barriers preventing the development of an ecosystem services state program to address multiple services in a programmatic, regulatory framework is needed. In spite of its success, the new Secretary of North Carolina Department of Environment and Natural Resources has stated in the past that it competes with the private mitigation banking industry in an unfair way and should be eliminated.

## **Ohio River Basin Trading Project**

The [Ohio River Basin Trading Project](#) is a nutrient trading program developed as a comprehensive approach implementing a nitrogen and phosphorus credit market. The program was designed to allow exchanges of water quality credits for nitrogen and phosphorus, and to create a viable market for the credits. The ecological objective was to protect or improve water quality for lower overall costs in the watersheds of the Ohio River Basin. The Electric Power Research Institute (EPRI) coordinates the Ohio River Basin Trading Project in behalf of the power companies, with additional funding support from municipal wastewater treatment facilities, and other local, state and federal agencies.

## **Oregon and Willamette Partnership**

The program for addressing ecosystem services at the Oregon Department of Transportation (ODOT) is summarized by Achterman and Mauer (2010). However, the most current and potentially useful work

related to an overall crediting system for transportation is a set of overlapping projects undertaken by Willamette Partnership. The work was initially focused on Oregon's Willamette Basin, but has expanded to the rest of Oregon and some of Washington. The project is focused on expanding the protection and restoration of ecosystem services by utilizing planning products and decision support tools that model the economic value of natural processes under different development/conservation scenarios. To date, Willamette Partnership has developed one of the most advanced and comprehensive structures to integrate the economic values of ecosystem services into multiple regulatory programs requiring compensatory mitigation.

Willamette Partnership is a 501(c)3 non-profit organization focused on developing markets based on detailed accounting procedures for multiple types of ecosystem service credits. It has worked to create science-based ecosystem service quantification methods in partnership with regulatory agencies and with agencies needing ecosystem credits. The process, called "Counting on the Environment", is a multi-stakeholder agreement to use a shared accounting system for quantifying impacts and benefits to ecosystems in a markets-based and/or mitigation banking system. The quantification methods and associated crediting protocols are designed to measure the functions and values associated with improvements and impacts to separate ecosystem services. Tools for measuring improvements and damages to wetland habitat, upland prairie habitat, sagebrush/sage-grouse habitat, salmon habitat, nitrogen and phosphorus loadings, thermal pollution offsets, and stream condition have been developed. Several site-based calculation methods have already been approved by state and federal regulators, including those for salmon, prairie, wetlands (the Oregon Rapid Wetland Assessment Protocol, or ORWAP), and water temperature. Willamette Partnership is currently working with Oregon DOT and Oregon Department of Fish and Wildlife to develop the quantification tools and protocols in order to pilot a mitigation banking approach to meeting fish passage requirements for ODOT projects. Results from the pilot will be available for review in June 2014.

The Partnership's General Crediting Protocol – which provides the rules for using the ecosystem service accounting system – references priority areas for ecological improvements to salmonoid habitat, prairie habitat, wetland habitat, and water temperature impairments. The Partnership identifies priority rivers and streams for improved salmon habitat based on National Marine Fisheries Service (NMFS) data, priorities for investment in prairie habitat and thermal pollution mitigation based on Willamette Basin Synthesis Map, and priorities for wetland mitigation based on the wetland priorities identified in the Synthesis Map, in areas surrounded by high-function wetlands as determined by ORWAP, or in wetland complexes with the highest restoration/mitigation scores in the newly developed state wetlands coverage (Willamette Partnership 2009).

The Synthesis Map was produced through a partnership of conservation groups, academics, and government agencies, including Oregon State University, the Oregon State Institute for Natural Resources (INR), and Willamette Partnership. It identifies priority terrestrial and freshwater sites for conservation and restoration within each sub-watershed of the basin. In order to include wetland restoration and protection priorities, the partners needed to update the wetlands dataset for the basin, which was a significant undertaking.

The two major components of the map are: 1) probable species distribution maps for three endangered plants and an endangered butterfly that occur on wetlands and upland prairies in the Willamette Valley (Achterman et al. 2011); and 2) data developed in support of the recovery efforts for threatened fish in the basin, most notably salmon.

Since the primary wetland compensatory mitigation activity is wetlands restoration, the project also developed a [Wetlands Restoration Planning Tool](#) that helps users identify the most appropriate sites and wetland types to target for restoration. Datasets used in the tool include the statewide wetland layer, rare wetlands, restoration targets based on 8-digit HUCs, locations of wetland mitigation banks and Wetland Reserve Program sites, wetland priority sites for the Willamette Valley, and hydric soils.

The Natural Capital Project, a joint research initiative between Stanford University, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund aims to develop and promote tools to integrate the value of ecosystem services into environmental decision-making. The project has evaluated ecosystem service values throughout the Willamette Basin and has produced one of the first published applications of a spatially explicitly modeling tool called InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) that places a monetary value on ecosystem services valuation, (Nelson et al. 2009).

It is worth noting that much of the completed work that Willamette Partnership was funded primarily with NRCS Conservation Innovation Grant dollars meant to help create markets for ecosystem services. Mitigation activity and planning were thus driven by a “markets” approach, which tends to demand both transparent criteria for measuring environmental improvements and damages and an assessment of benefits associated with alternative mitigation outcomes.

## **Regulatory Constraints and Institutional Barriers**

### **Local Government Issues with State, Regional and National Crediting Systems**

In some jurisdictions, statewide, large watershed or regional crediting strategies or conservation frameworks identify mitigation banks and restoration priorities that occur outside local jurisdictions – meaning local governments sometimes see these efforts as reducing their opportunities to conserve open space, wetlands and the amenities associated with these lands. As a result, local opposition, especially in communities where local jurisdictions have significant regulatory authority, can become a barrier to implementation of crediting and advanced mitigation. There have not been many studies examining this, but recent work in Oregon, in the city of Gresham and in the water management district for the Tualatin watershed demonstrated that a major obstacle to scaling down prioritization from the statewide level to local levels is lack of equivalent datasets. This is an issue because many of the characteristics needed to identify mitigation priorities that may be available at the local level, such as species distributions linked to stream reaches, are not available for entire watersheds. Several means to solve the data issue are recommended, including coordinating regional data collection efforts with local efforts; and creating incentives to get local jurisdictions to provide updates, on attributes such as wetland boundaries, to state agencies and groups working on developing regional priorities.

Aside from barriers related to the scale and availability of information, there can be real issues when areas best suited for restoration and mitigation are located within a watershed but outside the jurisdiction where mitigated losses are occurring. Eventually, an ecosystem services framework is perfectly suited for addressing these issues, because increased property values due to adjacent open space or recreational opportunities could eventually be included in the analysis that identifies priority mitigation sites. However, initially, regulatory agencies are likely to focus almost entirely on the ecological replacement and restoration needs.

### **Regulatory Constraints**

Most of the regulatory constraints related to developing or implementing a crediting protocol result from traditional regulatory barriers. Most if not all the regulatory agencies are interested in moving to functional approaches that allows for more effective and efficient mitigation projects. However, many regulators are so overwhelmed with current permit processing tasks that they find it impossible to find or make the time to implement a new approach, even if it were faster and more efficient. In this case, sharing already implemented projects from elsewhere in the agency may overcome this barrier. The priorities that OMB and CEQ have established to focus on streamlining while improving environmental outcomes have the potential to address this issue as well.

### **Funding and Organizational Barriers**

One of the biggest institutional challenges to both creating a regional ecosystem framework, and developing a debit and crediting system for services is convening the transportation and resource agencies and deciding on who will lead, maintain, update, warehouse, track transactions and fund such an effort (Institute for Natural Resources et al . 2012). This is a problem that results from agency silos, and occurs at both the state and federal levels. A regional or watershed conservation strategy with goals and objectives would be “owned” by EPA, USGS, USFS, BLM, USFWS, NOAA and other agencies. Current agency cooperation mostly involves communicating what each agency is doing; rarely, such as in the Landscape Conservation Cooperatives, having two agencies in the same department working together. In addition, mechanisms for integrating watershed or local scale priorities, methods, or plans into statewide or regional priorities, methods or plans also rarely exist, and almost never in state or federal government agencies.

## Summary and Conclusions

A significant amount of work is clearly needed before a straightforward methodology for creating a transportation centric crediting program is widely available. However, the successful programs in Oregon, California, North Carolina and Minnesota all have a number of attributes in common. First, the states created programs cooperatively with the regulatory agencies, state and non-governmental conservation programs, any people actively involved in mitigation banking, and the state, federal and foundations interested in funding restoration activities. There were various ways the different programs used to engage these stakeholders, but all engaged them early and often. In addition, most successful programs have included many of the components identified in the Integrated Ecological Framework (IEF), including the development of some type of comprehensive conservation strategy for the state, watershed, ecoregion or area in which the crediting system is to operate.

In general, because developing a crediting system related to regulated services is so complex, most existing programs limited themselves either to a single service, generally endangered species, wetlands or streams; or to a specific set of projects in a location, such as the Oregon Bridge Project. There are a few programs, most notably the General Crediting Protocol of Willamette Partnership, that work to develop a crediting system addressing transportation needs and multiple services. However, it appears likely that it will be a number of years before any program can provide meaningful guidance regarding a comprehensive crediting program for state departments of transportation or metropolitan planning organizations.

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# Appendix A: Steps for the Research Community

*This is from our [NCHRP 25-25 Task 67 final report](#), on Ecosystem Services and Mitigation, outlining the steps for the research community, on which I was a PI. This section was written by Dr. James Boyd, a social scientist and the expert in this area. It includes materials from 4-11 through 4-15. The third recommendation may be the one that is most relevant for transportation research.*

It is important to understand mitigation's implications (via effects on ecosystem services) for households, communities, and other stakeholders. Social evaluation of ecosystem service outcomes requires two basic things: (1) ecosystem service outcome or evaluation measures that allow for social, economic, and policy interpretation, and (2) the application of economic valuation or evaluation methods to assess the benefits of a change (gain or loss) in ecosystem services. Research in the following areas will support further advancements in effective mitigation.

## Identify the right ecosystem service measures

The centerpiece of ecosystem service-oriented mitigation policy is the definition, measurement, and evaluation of *ecological endpoints*. Biophysical production function studies should relate wetland mitigation actions to a specific, consistent set of outcome measures we refer to as “ecological endpoints.” Ecological endpoints are a distinct subset of the larger universe of biophysical outcome measures. By definition, ecological endpoints facilitate evaluation that can be expressed in social, economic, and policy terms. Ecological endpoints are biophysical outcome measures that require little further biophysical translation in order to make clear their relevance to human welfare. These endpoints are the essential bridge between biophysical and economic assessment.

Progressive planning and assessment requires us to measure ecosystem service outcomes whose value or importance can be meaningfully debated by stakeholders or detected by social scientists. In practice, this means choosing outcomes that are comprehensible and meaningful to non-scientists. Unfortunately, many of the most common mitigation outcome and assessment measures in current regulatory use do not directly facilitate or allow for economic evaluation. Outcomes like biotic integrity indices, chemical water quality concentrations, hydro-geomorphic classifications, and biological productivity are of scientific interest, are related to ecosystem services measurement, and establish the scientific basis for accurately modeling ecosystem functions and services. But without more intuitive, and tangible, measures of these benefits, stakeholders cannot evaluate and communicate their social value.

## Support more economic valuation studies

Economic and social evaluation is built around analysis of biophysical production – more specifically *changes in* biophysical production. If ecological evaluation can describe the relationship between mitigation interventions and the suite of subsequent changes, the economic benefits (or costs) of those endpoints changes can be evaluated. By design, endpoints are meaningful to decision-makers and

society generally. This means that changes in those endpoints can more easily lead to economic evaluation and valuations.

### **Develop “benefit transfer” capabilities and data**

It is usually not practical for mitigation planners to conduct original, site-specific studies of a wetland’s economic value. Such studies are expensive and time-consuming, and require special statistical skills. A cheaper alternative is to conduct “benefit transfer” studies.

The benefit transfer method takes the results of pre-existing valuation studies (conducted by academics, agencies, non-governmental organizations) and applies the dollar estimates to new environmental contexts. For example, if existing studies show that certain wetlands are worth \$500/acre, benefit transfer studies ask whether wetlands in a new context are worth more or less than \$500/acre. The challenge for benefit transfer methods is that the value of wetlands (and the ecosystem services they provide) is highly dependent upon the physical and social context in which they arise. Note that this is the primary motivation for pursuing the progressive mitigation concept. For the analyst, benefit transfers requires methodological and conceptual sophistication. In order to judge the relevance of a particular study to a new site, it is necessary to know how comparable those sites are. Like any benefits, environmental benefits are a function of scarcity, substitutes, and complements. In order to transfer benefit estimates to new sites, it is necessary to adjust for these kinds of factors.

### **Research on non-monetary approaches to social evaluation**

Monetary valuation requires the use of methods that substantially add to the planner’s assessment burden. Most decision-makers also find econometric tools excessively complicated. This can undermine trust in economic assessment and limit the application of economic arguments in certain decision contexts. An alternative approach is the use of quantitative ecosystem benefit indicators (EBIs).

EBIs are quantifiable features of the physical and social landscape that can be used to evaluate ecosystem service benefits and thereby relate to and describe the value of endpoint changes. They can usually be derived easily from existing geospatial datasets. EBIs relate ecological endpoints with data on the endpoint’s scarcity, substitutes, and complements and with rough measures of the populations and economic activities they support.

# Appendix B: Integrated Ecological Framework Step 6

*These are the updated pages from the DRAFT Managers Implementation Manual developed as part of the C06 outreach project. They are included here to provide additional guidance.*

## STEP 6: Develop a Crediting System

### Purpose

Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long term performance at the project level to ensure consistency with mitigation objectives; and to allow for greater efficiency in identifying mitigation and restoration opportunities that address multiple services, and impacts.

### Outcomes

- Improve and integrate the mitigation sequence at a site level through avoidance and minimization, after which outcome based performance standards can set the stage for compensation
- Accelerate project implementation and improve mitigation outcomes.
- Reduce the transaction costs for mitigation and restoration.
- Support implementation of advanced mitigation, mitigation banks, and programmatic permitting and agreements.
- Support use of offsite mitigation and out-of-kind mitigation where appropriate, since equivalency of value can be determined across locations and resources.
- Inform adaptive management and updates of the cumulative effects analyses.
- Balance gains and losses of ecological functions, benefits and values associated with categories of transportation improvements or specific project related impacts
- Provide the means of tracking progress towards regional ecosystem goals and objectives (assumes site level ecological metrics are correlated to the landscape level tools used to define the REF).
- Characterize project mitigation benefits related to currently unregulated services, such as carbon storage or late season water provision which could provide additional funding for mitigation or could impact selection of mitigation sites.

### Prerequisites to Conducting Step 6

- Regional mitigation strategies and other parts of Step 5 can significantly reduce the time and effort involved in this step.
- Many states have function and service based inventory methodology included in their regulatory framework (such as Rapid Wetland Assessment Protocols), which have been developed to measure current functions and services. When adopted by the regulatory agency, these can provide a critical head start in this process.

## Implementation Steps

- 6a. Evaluate effort to be included in this step.** Ecosystem service measurement and crediting tools are being rapidly developed across the country. As a result, their adoption and the methods, tools, or markets may not exist in many the area, and therefore implementing such a program may be too costly or time intensive. To determine if adopting or implementing the program, the easiest method is to evaluate the plan (anything from a STIP, Corridor or project plan works) to determine if the project(s) are likely to have significant intersection with regulatory resources, particularly streams, rivers, wetlands or endangered species. If the work in steps 1-5 indicate that significant mitigation requirements are likely, developing a crediting system is likely to be both beneficial can cost effective.
- 6b. Diagnose the measurement need.** Define which ecosystem services need to be measured, or which could be beneficial and straightforward to measure. This includes examining the regulated ecological services potentially to be impacted by transportation projects in the watershed or REF area, as well as other non-regulated resources which may be important within the ecological setting. Wetlands often provide multiple services, and so can be somewhat difficult, but clean water act services, including stormwater, temperature, and nutrients are often impacted by projects, and with a crediting protocol developed and accepted, mitigation can be faster and provide better ecological outcomes.
- 6c. Identify Ecosystem Crediting Platforms or Protocols developed within the region, and evaluate their ability to be used in the REF ecosystems and landscapes.** Currently, extensive frameworks have been developed in California, Oregon, the upper Midwest, and the Chesapeake Bay. New work is ongoing in many other areas of the country, and state and regional protocols can be found on the Ecosystem Commons portal (<http://ecosystemcommons.org>) or the [Ecosystem Marketplace](#).
- 6d. Select or develop units and rules for crediting.** If existing crediting platforms exist, these define regulator approved rules for field measurement of ecological functions, approved mitigation/conservation banking, outcome-based performance standards, and how to buy and sell credits, and should always be used or at a minimum, evaluated. When these do not exist, they can be adopted those developed from the most similar landscapes and ecosystems, although this will require steps 6d – f. If they are available, steps 6d- 6e can be skipped.
- 6e. Test applicability of units and rules in local conditions and evaluate local opportunities.** If new rules or methods for service measurement or crediting have not been developed, this can be time consuming, but as is the case with 6c above, methods can be most easily adopted from adjacent areas. This includes a review of the protocols by the primary regulatory agencies along with other important stakeholders.
- 6f. Negotiate regulatory assurance for credit.** Existing approved banks or credit registries such as [markit](#) or [tz1market](#) provide assurances for credits they sell. If new banks or registry programs are being developed, they are most effectively developed in concert with the various regulatory agencies, usually tied to programmatic agreements.

**6g. Program implementation.** Active programs have been developed in [Oregon](#), [Maryland](#), [Minnesota](#), and [North Carolina](#); and almost all of these are willing to share methodologies and tools. [The Bay Bank](#) (Chesapeake Bay), [Willamette Partnership](#), [The Natural Capitol Project](#), the [United Nations Environment Program](#), and [Earth Economics](#) all provide guidelines and program implementation examples and guides.

## Technical Considerations

- How will debits/credits be calculated? Assure reasonable ratios allow for mitigation to be most effective, while discouraging incompatible development.
- Is credit stacking allowed? Credit stacking can promote mitigation in sites that have multiple values, but regulators generally ONLY focus on the one resource for which they have legal responsibility. So stacking should be used to take advantage of multiple credit needs, without reducing the requirements for any regulated resource.
- What is the permissible service area for a bank, off-site mitigation? If possible, EPA and Army Corps rules can establish within watershed guidelines, perhaps at the 10 digit watershed.
- How will credits be registered and tracked? Whenever possible, use existing credit registry companies that are licensed and bonded, such as Markit Environmental Registry.
- How long are regulatory decisions on a given project binding? Most credits and mitigation banks release credits after 5 years and usually binding for 20 years.
- What long-term monitoring is needed? Monitoring is usually tied to mitigation banks, and are tied to the release of credits. Long-term monitoring should be established to evaluate both restoration effectiveness and the overall uplift for all of the at-risk values in the watershed.