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Valuing Ecosystem Services to Inform Conservation and Development Decisions

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Costs to provide essential public services, such as drinking water, wastewater treatment, and stormwater management, often strain municipal budgets. In response, communities are increasingly looking for alternative ways — beyond traditional infrastructure investment — to provide these services. One cost-effective option is to rely on the resources and processes that natural resources can supply. These functions, often called ecosystem services, can complement — or even offset — traditional infrastructure.

For decision makers, having a better understanding of an area's capacity to supply ecosystem services and the value of that capacity, also allows them to better compare development alternatives. By more fully understanding the risks and costs of ecosystem impairment, decision makers can make better-informed choices and achieve more sustainable economic development on local and regional levels.

This *PAS Memo* outlines an ecosystem services planning and implementation process. This process can help a municipality identify ways to maximize the value received from its natural resources, both today and in the long term. To help demonstrate how ecosystem services valuation can be used in practice, three case studies show how planners can use this approach for regional redevelopment, water resource conservation, and private engagement in stormwater management.

Throughout this process it is important to engage stakeholders at each step to ensure that all involved help define the natural resources, their potential services, the barriers to be addressed, and the goals to be achieved. A sidebar provides suggestions on engaging stakeholders at each step in the process.

An Introduction to Ecosystem Services

There are numerous ways that natural resources provide infrastructure services. They can:

- collect stormwater during rain events and treat it before it is released into groundwater or surface water
- reduce the impact of floods and even prevent them from happening
- conserve and ensure a safe water supply by reducing demand and protecting water quality
- manage climate impacts and reduce "heat island" effects

Ecosystem services have direct economic value because they help reduce demand for resources and in turn reduce costs. For example, trees provide shade, reducing ground surface temperatures and subsequently reducing energy demand for cooling. Natural resources also generate indirect economic benefits when they provide open space amenities and quality of life improvements.

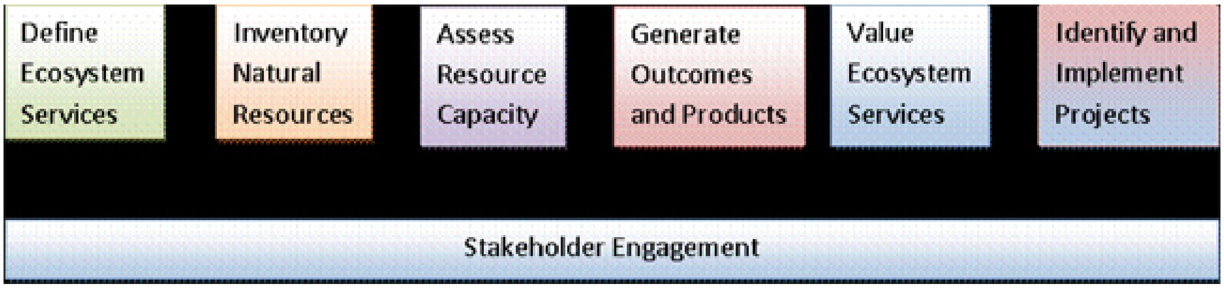
However, while natural resources provide multiple functions that have economic value, historically their ability to do so has not been fully accounted for. As a result, this value has not commonly been factored into planning and decision-making processes. Work performed in the late 1990s by environmental economists to determine the monetary value of ecosystem services has estimated a global average value of $33 trillion annually (in 1997 dollars; ASLA et al. 2009).

Because of an increasing awareness of the important role that natural resources play in providing critical community services, new planning tools and valuation methods are emerging that consider these resources. These techniques provide a way to quantify the value that is added by ecosystem preservation and restoration projects and the economic impacts of ecosystem degradation and loss.

A Framework for Ecosystem Services Planning

Planners can use the ecosystem services planning process to help better value their municipalities' natural resources and create development and conservation plans that can lead to integrated achievement of economic, environmental, and social goals. The phases included in building this decision-support platform are illustrated in Figure 1 and described in more detail below.

Figure 1.



Natural Resources Assessment and Valuation Process. Source: Cardno

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Define Ecosystem Services

At the beginning of any planning process, there needs to be a robust understanding of what the term "ecosystem services" means. Natural resources can generate a range of services that can be relied upon at the site level, on the larger community level, and even on the global level. Understanding these services and the appropriate scale(s) at which to assess them is an important first step to take.

To help make the concept of ecosystem services more concrete, a group called the **Millennium Ecosystem Assessment** has developed some examples of ecosystem services, based on the idea that they can provide, regulate, support, or enhance a variety of functions. Table 1 provides some examples of what these functions can include. Note that a particular resource may provide one or several of these services.

Table 1: Examples of Ecosystem Services

Provide	Regulate	Support	Enhance
Fresh water	Flooding	Water table recharge	Recreation
Food	Water quality	Nutrient cycling	Culture
Fiber	Erosion	Species survival	Aesthetics
Energy	Air quality		Architecture
Biochemicals	Pests		Education
	Disease		
	Natural hazards		
	Climate		

Source: Adapted from the **Millennium Ecosystem Assessment**

Some of these services are straightforward to understand: for example, wetlands provide flood regulation, water purification, climate management, water table recharge, recreational services, and aesthetic services. Others are more complex, such as the ability of a species to help cure diseases or to create conditions that are conducive to the needs of future generations, such as soil health. Depending upon the goals of the project, the key stakeholders, or other factors, planners can define a wide variety of services.

Inventory Natural Resources

A natural resources inventory documents the presence of any natural resources and their ecological relationships. Natural resources occur in different forms: they can be pristine prairie remnants that can be easily identified, or they can be areas with no native plant communities present, but with natural and undisturbed underlying soil horizons that have habitat restoration potential.

A comprehensive inventory identifies these assets, which might include:

- General plant communities
- Critical or important species and their related habitats
- Certain soil types
- Hydrologic features
- Topographic features
- Protected open space

In the past, creating natural resources inventories was difficult because of lack of data, and data that were available were often not in electronic geographic information system (GIS) format or at appropriate spatial resolutions.

Today, the required spatial data can often be obtained through federal and state web-accessible data servers, making the process much easier. Also, much of this information is now available as GIS shapefiles, which are files with tables of data and the information to display that data correctly as a spatial image. Some data, such as the location of plant communities, may need to be mapped by analyzing multispectral aerial or satellite imagery. Some information may also need to be collected in the field (for example, through ecological assessments) or converted from hardcopy to GIS format. Despite these additional steps, the data are now available or easily accessible for a comprehensive natural resources inventory.

The inventory is often completed by compiling data in a GIS or a geodatabase, which stores, queries, and manipulates geographic information and spatial data. The table structure of a geodatabase allows data to be used more efficiently and accurately.

Assess Natural Resource Capacity

While natural resources have innate ecosystem services, their ability to provide those services is often lessened by land-use activities. When assessing the capacity of natural resources to provide ecosystem services, it is important to document those factors that cause positive and negative impacts to develop effective land-management strategies.

Impervious cover is a prime example of a factor or condition that can have negative impacts. Stormwater runoff that is discharged from impervious land cover can add pollutants to an adjacent water body or cause excessive runoff.

Another example is invasive plant species, such as common reed (*Phragmites australis*), which can suffocate native plant communities and degrade habitat, interrupting food-chain relationships and causing a decline in species diversity.

External conditions and activities can also have a positive impact on natural resources. They can help maintain the quality of natural resources or ensure they are protected. For example, it is important to document land-restoration activities that improve habitat quality and legal mechanisms that limit land development. It is also important to document any elements of zoning ordinances and other regulations that impede the full capacity of these resources.

Produce Analysis Outcomes and Products

The first three phases in the framework shed light on the assets that are available and the factors that either support or hinder them from providing their services. To guide this process, it is important to identify desired outcomes and products. This step should occur early in the process, so that all activities support the outcomes.

The desired outcomes can have many forms. For example, they could include:

- An understanding of the location, extent, condition, and importance of natural resources for the particular planning activity
- An assessment of the impacts that conditions and activities are potentially having on natural resources, in preparation for identifying solutions
- The capacity to prepare a comprehensive evaluation of the aggregated impairments to ecosystem services that have occurred as a result of human activities

The products that could be developed to support these outcomes might include:

- A translation of ecosystem service values into quantitative information
- A geodatabase to manage and integrate spatial information
- Maps of assets and threats
- Diagrams defining positive and negative relationships between assets and threats
- An assessment of where and how natural resources have been degraded in recent years

These outcomes and products provide the foundation upon which cost/benefit analyses and natural resource management plans can be built.

Valuing Ecosystem Services

To give outcomes and products the weight they need for decision-making purposes, the underlying natural resources need to be given quantifiable value.

When natural resources are seen as a form of capital, and their services are given accurate economic value, planning models can be transformed to fully account for investment in ecosystems protection. This process requires identifying the relationship of ecosystem structure and function to human behavior. Developing the link between ecological production and economic valuation is imperative to affect how humans interact with natural resources through policy and planning mechanisms.

Models that are currently used for valuing economic impacts can also be used for natural resources valuation. Input-output (I-O) analysis is one tool used to measure the economic impact of investments, including public investments in natural resource restoration and conservation.Used by municipal planners and budget managers, I-O analysis measures job impacts, income changes, and spending changes related to local or regional economic development. The I-O tool most commonly used to measure economic impacts related to natural resources is **IMPLAN (Impact Model for Planning),** which the U.S. Forest Service designed for community impact analyses. The USDA Natural Resources Conservation Service uses this model extensively to estimate economic impacts for watershed analysis, conservation initiatives, and local natural-resource planning.

In addition, there are advanced methods for valuing ecosystem goods and services that rely on extensive data collection, usually through surveys. These methods go beyond estimates of jobs and spending to measure economic benefit and welfare. The methods include **Hedonic Property Method**, **Travel Cost Modeling for Recreation**, and **Contingent Behavior and Valuation Method**. Because they require significant economic expertise and funding, primary valuation studies have traditionally been left to researchers.

Fortunately, several methods use existing studies and apply those estimates to specific cases. These cost-effective alternatives provide techniques that local and regional governments may use immediately. Examples of these alternatives include:

Avoided Costs. Ecosystem benefits can be measured by the costs avoided because of the services they provide. Examples of such avoided costs include reduced infrastructure spending on flood control, water treatment costs associated with storm events, and energy costs associated with heat-island effects.

Replacement Costs. Similar to avoided costs, replacement costs are the costs of replacing ecosystem services from wetlands, beaches, and green spaces with built infrastructure solutions. Market prices and engineering costs are two readily available sources of these types of costs and benefits.

Benefit Transfer and Meta-Analysis. Both benefit transfer and meta-analysis can be used with avoided costs or replacement costs to capture a full economic value of ecosystems. This step goes beyond cost data to include quality-of-life improvements associated with recreation, aesthetic improvements, and civic engagement, for example. While the data used for benefit transfer and meta-analysis come from existing economic literature, with careful adjustments they can be used for specific projects. The accuracy and reliability of economic value estimates can be greatly improved through integrated ecological data collection and economic valuation, which to date has not been widely applied in planning frameworks.

Identify and Implement Projects

Once the outcomes, products, and natural resource values are generated, this information forms a decision-making platform that can be used at a variety of scales for various projects, from broad-scale comprehensive planning to site-specific implementation actions. Not only are natural resources and their functions identified, but those functions are given value, which then helps stakeholders better understand how ecosystem services can provide a variety of benefits. For example, the idea of creating green infrastructure can go beyond creating green spaces and can expand into providing viable solutions to stormwater and flooding problems, and decisions can be made based on financial as well as environmental benefits.

Actions can be part of a specific site plan, or they can be defined more broadly and incorporated into a local or even regional comprehensive plan process. They can also be integrated into a menu of plan implementation options. One of the most powerful tools is capital improvements plans, which implement the construction and renovation actions that require public funding. Including the outcomes from a natural resources valuation process into an established plan can help to ensure that this process becomes reality; for example, wetland restoration could be integrated as part of a flood management program.

Case Studies

Cardno JFNew and Cardno ENTRIX, partner ecological restoration and environmental consulting firms, use ecosystem services valuation as a key part of their professional approaches. Provided here are three different examples of how the firms have used ecosystem services to help clients and stakeholders make development and conservation decisions, including a regional redevelopment plan, a water-supply management strategy, and private-sector participation in stormwater management.

Gary Airport Redevelopment Plan

In May 2011 the Gary/Chicago International Airport Authority embarked on an airport expansion project, which involved expanding the airport's main runway and its associated taxiway to the northwest by approximately 1,900 feet to address safety issues related to a shorter runway. Construction started in 2012 and is expected to be completed by December 2013.

- Environmental legacies that require remediation before reuse can happen
- Ecologically sensitive and unique habitat, endangered species, and jurisdictional wetlands
- Strategic economic redevelopment to restart the local economic base

To help focus the area's redevelopment potential so that environmental resources would be protected or even enhanced, the Northwest Indiana Regional Development Authority (RDA), with additional funding support from the Gaylord and Dorothy Donnelly Foundation, retained Cardno JFNew and Cardno ENTRIX to create a conservation and development plan that would achieve a balance between environmental preservation and economic interests in the airport development zone.

To achieve this outcome, the Cardno team embarked on a three-step process:

- *Assess Conservation Value*: Identify and prioritize parcels with ecological assets to protect, restore, or enhance for habitat connectivity and other environmental benefits
- *Analyze Economic Development Potential*: Identify and prioritize parcels with economic redevelopment and revitalization potential, working within the context of previous planning efforts, stakeholder input, and current conditions
- *Locate Prime Redevelopment Sites*: Synthesize conservation value with economic development potential to establish a land redevelopment and conservation strategy

Assess Conservation Value. Working with previous planning efforts and studies, Cardno developed a conservation value assessment of the land within the study area. This assessment identified and quantified environmentally sensitive sites and helped create a priority ranking so that the RDA and others could take a strategic approach to land use. This process helped to diminish conflicts between the conservation and economic development communities. Open space was defined as having high, medium, or low conservation value, or as land that was either permanently or currently protected (see Figure 2).

High Conservation Value:

- Intact dune and swale physical structure, including hydrology and beach ridge formation
- Representative dune and swale plant assemblages present and in good condition
- Previously designated as a regulated waters, either through the National Wetlands Inventory, floodplain maps, hydric soils, or other features
- Known presence of federal- or state-listed species, species of conservation concern, or element occurrences
- Direct habitat connectivity and/or supplemental habitat to core biodiversity sites, i.e., Indiana Department of Natural Resources (Indiana DNR) dedicated nature preserves
- No environmental legacies, hazards, or contamination known to be present

- Physical disturbance considered light or moderate

Medium Conservation Value:

- Marginal ecological value under existing conditions, but has restoration potential
- Intact dune and swale physical structure, including hydrology and beach ridge formation
- Representative dune and swale plant assemblages compromised or degraded by invasive species
- Designated as a regulated waters, either through the National Wetlands Inventory, floodplain maps, hydric soils, or other features
- Provides supplemental habitat/habitat connectivity for permanently protected areas and species of conservation concern
- Physical disturbance considered moderate or in some instances severe
- No environmental legacies, hazards, or contamination known to be present

Low Conservation Value:

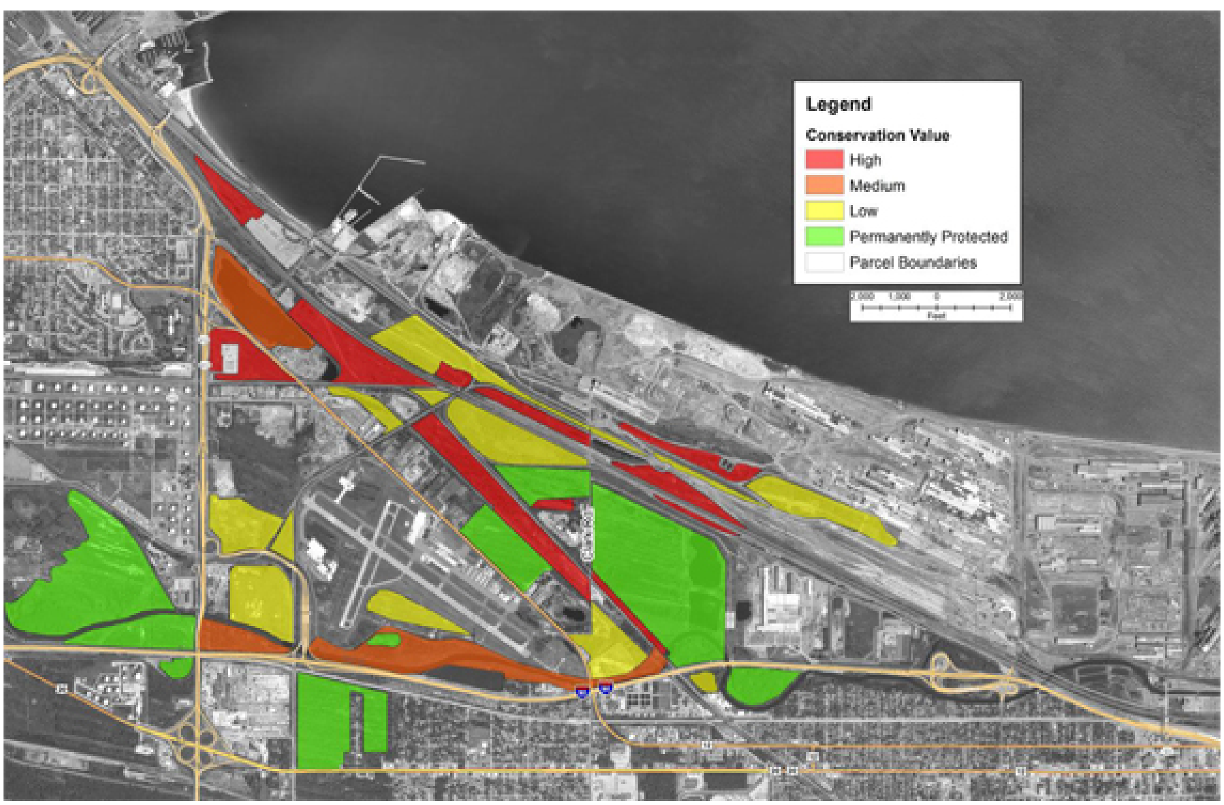
- Demonstrates severe and extensive physical disturbance with irreparable damage overall
- Shows impaired ecological function and loss of native species
- Altered hydrologic function with severely degraded ecological conditions
- Limited habitat connectivity that would require extensive restoration to achieve connectivity
- Environmental legacies and contamination known to be present

Permanently or Currently Protected:

- Owned and managed by conservation organizations, including the Indiana DNR properties
- Include properties owned in fee title, under a conservation easement, restricted by Land and Water Conservation Fund (LWCF) or Natural Resource Damage Assessment (NRDA) funds, or a combination

Natural areas that are currently protected typically represent core biodiversity sites. These sites have the highest ecological quality in the region and are considered to be state, regionally, and globally significant ecosystems. For any future redevelopment efforts, these parcels should not be considered to have redevelopment potential, because of their protection status, their high ecological value, and the significant mitigation requirement that would have to be met to offset impacts.

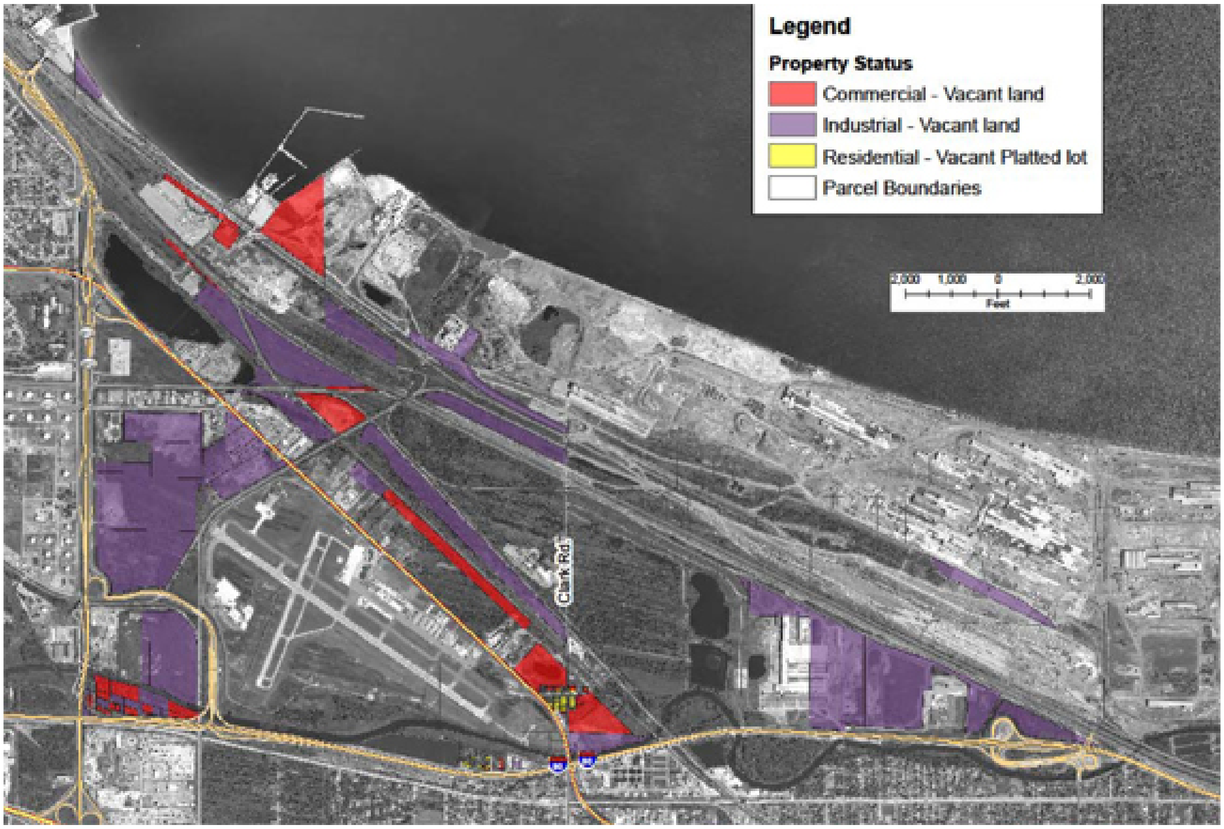
Figure 2.



Conservation Value Map. Source: Cardno

Analyze Economic Development Potential. The economic potential analysis component of the project examined the inventory of available land in the study area, focusing on the amount of land currently classified as vacant and considering it in the context of current zoning. As of March 2012, a total of 783 acres, or 17 percent of the study area, was considered to be vacant. Figure 3 shows the location of all the vacant parcels within the study area and their zoning category classifications.

Figure 3.

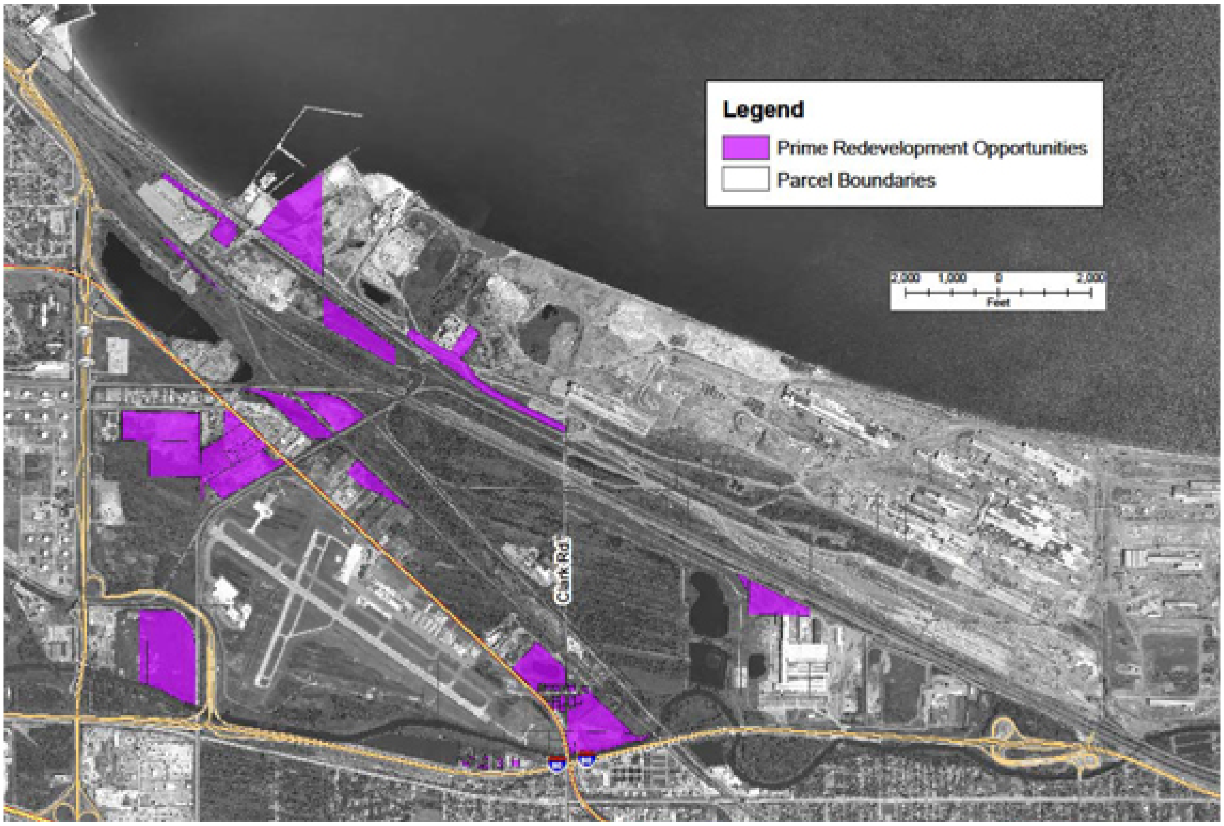


Zoning of Vacant Lands. Source: Cardno

Prime Redevelopment Locations. While the study area was found to have a significant amount of vacant land, that land may not be suitable for economic redevelopment based on environmental factors. As Figure 2 shows, throughout the study area there are lands that are constrained from development because of contamination issues or their high natural-resource value (and subsequent protection or high mitigation requirement if impacted).

By overlaying the vacant lands map on the conservation value map, Cardno identified prime redevelopment parcels. Figure 4 below presents the vacant land on the site that has either a low conservation value or does not have any conservation value associated, making it prime for redevelopment efforts.

Figure 4.



Prime Redevelopment Opportunities. Source: Cardno

The ultimate outcome from this project is to make sure that any economic development activity within the study area accounts for and accommodates environmental considerations, which include, but are not limited to:

- Protection of state and federally protected parcels, species of conservation concern, and areas classified as high conservation value
- Regulated wetlands and endangered species
- Environmental legacies and brownfields

In acknowledging and accounting for these considerations, the conservation and development plan will help economic development activity avoid longstanding conflict with the environmental community and regulatory authorities.

Northern Everglades Payment for Environmental Services

An ecosystem services approach can also be used to achieve statewide goals over several sites. One example is in Florida, where water management is critical to achieve. In coordination with the Florida Department of Agriculture and Consumer Services (FDACS), Florida Department of Environmental Protection (FDEP), and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the South Florida Water Management District (SFWMD) created the **Dispersed Water Management Northern Everglades – Payment for Environmental Services (NE-PES) program**. The program's goal is to establish relationships, through contracts with private landowners, to obtain water- and nutrient-retention services to reduce flows and nutrient loads to Lake Okeechobee and its estuaries while enhancing the economic stability of working agricultural lands. The program allows landowners to receive financial benefits from their property's environmental characteristics and keep the land in family ownership rather than sell it.

The NE-PES program came about as a result of the **Florida Ranchlands Environmental Services Project (FRESP)**, which was created to help develop market-based approaches to achieve water and nutrient retention across the state.

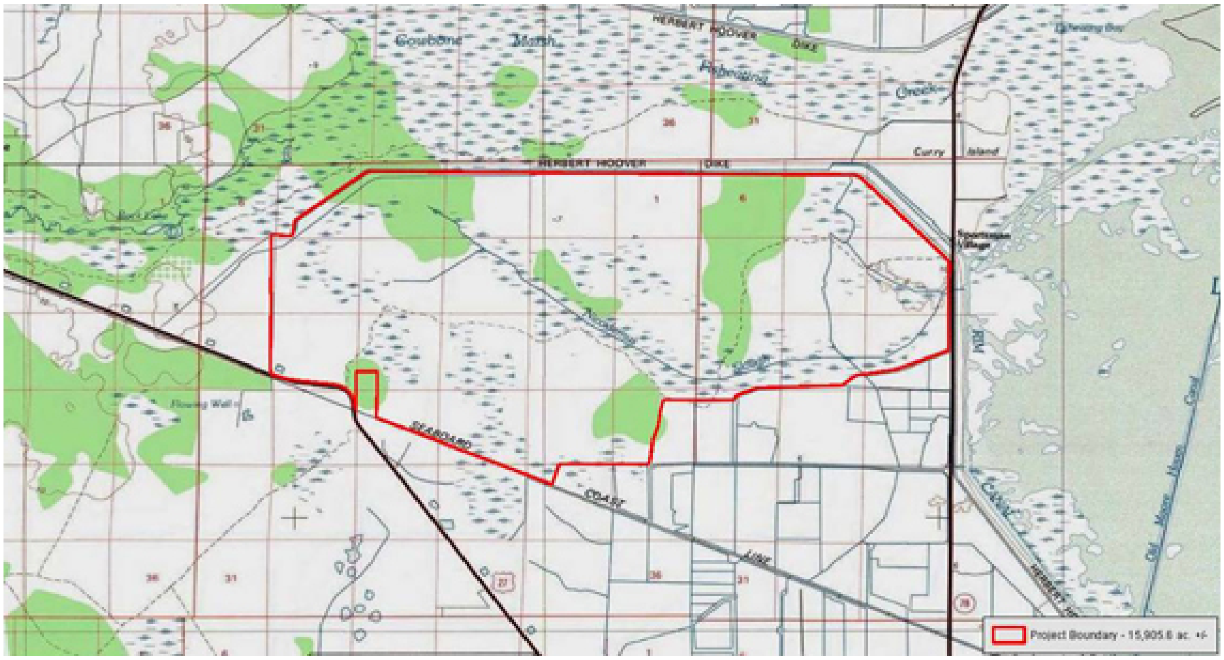
To start off the NE-PES program, the state selected the Nicodemus Slough site as a pilot project to test out the process. This site was selected in particular based on its size and related improvements, which would allow it to provide the primary ecosystem service, water management.

The Nicodemus Slough pilot project consists of a 15,906-acre degraded wetland on the west shore of Lake Okeechobee in Glades County, Florida. The site has existing connections to both Lake Okeechobee and the Caloosahatchee River (see Figures 5 and 6). These connections provide the opportunity for multipurpose water-management operations, which will vary as hydrologic conditions change throughout the year. In addition to its natural attributes, the site also has a significant amount of existing infrastructure, including 15.7 miles of existing perimeter levees, which aid flood control on the site. The overall project intent is to store water in the Nicodemus Slough system to reestablish a more natural sheet flow of water across the site, enhancing and restoring wetlands.

Figure 5.

Nicodemus Slough Project Location. Source: SFWMD

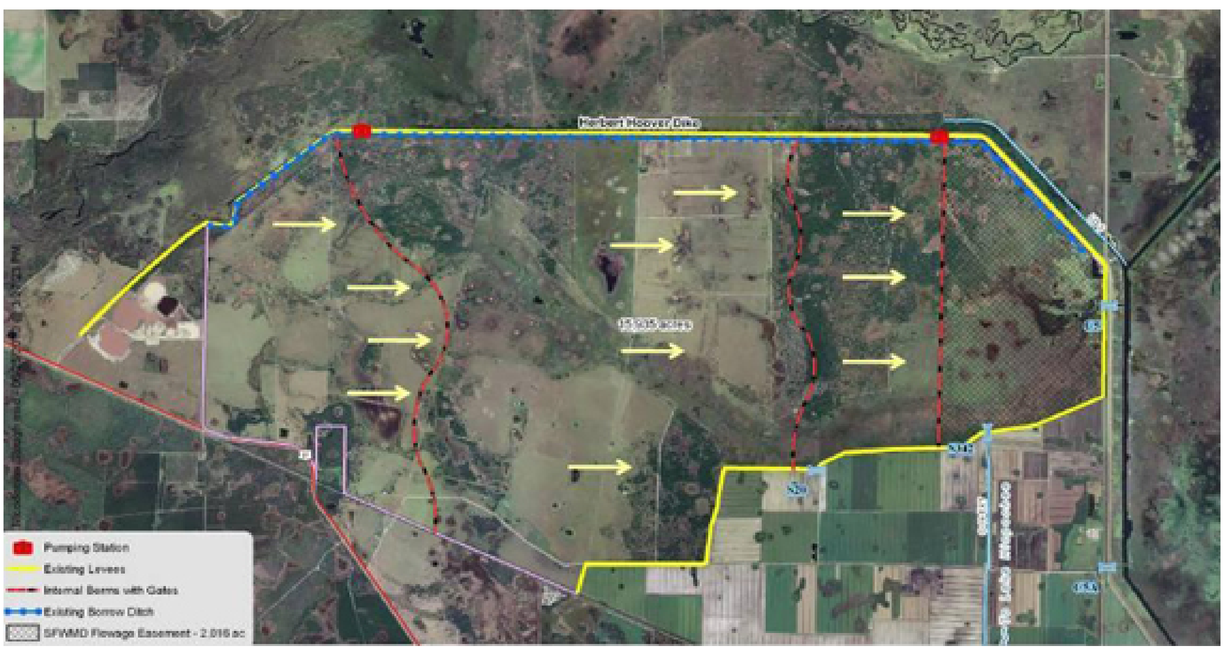
Figure 6.



Nicodemus Slough Environmental Resources Map. Source: USGS

To create the optimal design for the project, Cardno ENTRIX developed 14 alternative ways of handling surface water flow into the Nicodemus Slough property. This initial list was narrowed down in partnership with the State using a design selection criteria process that evaluated each alternative based on the projected water storage volume, technical suitability for the site, and the permitting required. From this effort two alternatives were selected for modeling, and from the modeling the final project was selected (see Figure 7).

Figure 7.



Existing Levees, Nicodemus Slough. Source: Lykes Brothers Properties

During high-water events, surface water will be pumped from Lake Okeechobee to the western end of the Nicodemus project site. Water will be staged behind a series of three low-head berms to allow for natural treatment processes to occur as water flows across the site. The project, which has an estimated $5.1 million construction cost, has the potential to store 30,300 acre-feetof water from Lake Okeechobee.

Use of the site has been established under a 10-year lease agreement between the state and the landowner, with annual payments to the landowner of $150 per acre per year, an annual total of $2.1 million. Partial lease payments will be made as land is taken out of production for construction. Site operation and maintenance is set at a not-to-exceed amount of $400,000 per year, with an annual adjustment of 3 percent or the consumer price index (CPI), whichever is greater. The total contract is set at a not-to-exceed amount of $28.6 million.

The project provides an opportunity for the SFWMD, through a lease/project agreement, to effectively and significantly expand its water resource management facilities to benefit the public and natural systems in a relatively short time, using a natural resource to perform these services.

Valparaiso Willingness to Pay for Ecosystem Services Study

Ecosystem services valuation can also be used to gain private-sector involvement to address specific issues. Cardno JFNew, in partnership with RCF Economic and Financial Consultants, and Futurity, Inc., a spatial analysis environmental consulting firm, developed a Payment for Ecosystem Services (PES) valuation study for a stormwater green-infrastructure auction in Valparaiso, Indiana, with funding from the U.S. Forest Service, the Northwest Indiana Regional Development Authority (RDA), and the City of Valparaiso Utilities Department.

The project was conducted in Valparaiso's Memorial neighborhood, selected as the priority watershed for the study due to ongoing issues with basement flooding, sewer backups, and numerous combined sewer overflow (CSO) events that have had adverse effects on water quality in Salt Creek, which drains to Lake Michigan. The neighborhood contains approximately 550 homes and a few small businesses, and the community as a whole is aware of and interested in stormwater issues.

The study had three main components: (1) conduct a neighborhood stormwater education program and auction; (2) develop a decision support system (DSS) software to rank auction bids and manage the auction process, and (3) design and install stormwater best management practices based on the selected bids.

The education program provided residents with information on the benefits from rain gardens and rain barrels and provided them with typical per unit costs, to help residents understand the market values of these systems. The auction, which was held in May 2011, resulted in bids from approximately 10 percent of property owners in the neighborhood that were then selected for installation of either a rain barrel or a rain garden based on two factors: the amount property owners were willing to pay and their property's suitability for the selected stormwater infrastructure based on the amount of runoff to be captured.

A total of 38 rain barrel bids and 19 rain garden bids were received. The average rain barrel bid for the first barrel was $59; the average bid for all rain barrels was $48 (owners could bid on more than one barrel, so with the additional bids, the average bid amount decreased slightly), and the maximum rain barrel bid was the market price of $250. The average rain garden bid was $393, with a maximum of $1,850.

To encourage participation in the program, any rain barrel bid greater than $0 received a barrel. By August 2012, Cardno JFNew had installed 61 rain barrels at 30 locations for 28 property owners and collected bid payments of $3,428. Installation costs were covered by grant funds. To help ensure long-term success, each property owner was provided a flyer providing rain-barrel maintenance tips.

For the rain garden program, the bid selection process involved estimating the amount of rainwater that would be captured and maximizing the cost, estimated to be $3.80 per gallon. A total of 12 rain gardens bids were constructed, with bid payments of $4,537 collected. All rain gardens have been constructed (see Figure 8).

Figure 8.

Rain Garden Installation, Valparaiso, Indiana. Source: Cardno

Beyond installing BMPs and improving understanding of the value of green infrastructure in the Memorial neighborhood, the study also creates a replicable, scalable auction and outreach model that can be used throughout the Great Lakes to encourage private property owners to adopt stormwater best management practices.

Action Steps for Planners

Planners can use ecosystem services valuation as a decision-making tool to achieve numerous goals. To help integrate this approach into practice, here are some suggestions:

1. Use the Millennium Ecosystem Services information to develop a better understanding of the ecosystem services potentially available in your community. Create a similar table for each natural resource, determining what each resource provides, regulates, supports, and enhances. This information is a useful first step to place an actual value on the resource.
2. Determine the current status of any mapping of your jurisdiction's natural resources, and identify what data might need to be collected or created. Before purchasing any data layers, check with your state's natural resources agency to see what data are available publicly, and at what resolution. The smaller the scale of your site, the higher the resolution the data layer needs to be.
3. Connect with other departments in your community to see what information they have that would inform your understanding of local natural resources. Parks, public works, and transportation departments may all have data that they have collected for a particular purpose that could be useful. Obtaining data, and using that data in a strategic way based on the needs of the target audience, will be critical to project success.
4. Identify allied professionals to assist with key action items. For example, in addition to GIS professionals who might be needed to develop data layers, you may need to connect with environmental scientists to identify and assess additional resources, with environmental economists to assist with determining values, and civil engineers to develop concept designs, if working on a site-specific project.

5. Create a community outreach strategy to expand the public's general knowledge and understanding of the concept. This strategy will vary, depending upon the level of engagement already present. Consider using existing venues like farmers markets or volunteer events to provide programming or materials. Customize the information within the context of the community's current issues. For example, talk about the benefits of wetlands in flood-prone areas.
6. If starting a planning process, integrate this information into the existing conditions assessments, scoping of issues, and possible action items. If you already have a comprehensive plan or neighborhood plan, review the implementation action items that could be addressed directly or supplemented by natural resource functions.
7. Identify a potential pilot project and seek out possible grant funding from private foundations, state agencies, or federal agencies to design and implement the project. Be sure to engage community groups in the grant development process and throughout the project. See the sidebar for stakeholder engagement tips.

By mapping and placing a value on natural resources, planners can work with decision makers and stakeholders to determine how the functions of these resources can be employed to address specific problems or situations, maximizing budgets and public funds.

Engaging Stakeholders

The following are some suggestions for engaging key stakeholders and community members in the discussion for each step of the ecosystem services planning process.

Define Ecosystem Services

- At the beginning of the process, identify the key stakeholders to involve, including community members, interest groups, agencies, and elected officials.
- Engage community members to develop a common vocabulary on ecosystem services and identify broader community goals.
- Establish relationships with interest groups, agencies, and elected officials to understand needs and project requirements.
- Determine if project is part of a larger planning activity or involves a separate implementation plan.
- Be consistent with other plans.

Inventory Natural Resources

- Engage stakeholders to help with the inventory process and provide existing GIS data layers.
- Consider using students or other volunteers to do field data mapping work.

Assess Natural Resource Capacity

- Talk to stakeholders about what have historically been issues in the community. They may have anecdotal information that could lead to discovering other issues.
- Work with local government officials to identify mechanisms in place that are impeding any natural resources functions.

Produce Analysis Outcomes and Products

- Present these outcomes and products to the community at a public meeting, at a school venue, or other public mechanism.
- Allow for questions and comments, and be open to changes. The goal is for the stakeholders to own the process and the outcome along with the project leaders.

Valuing Ecosystem Services

- Engage stakeholders in the valuation process to identify the best method to use to determine the values.
- Keep them involved and informed throughout the analysis to ensure that the process remains transparent.

Identify and Implement Projects

- Involve stakeholders in alternatives analyses to identify scenarios that address the community needs or issues.
- Ensure that any actions taken are consistent with existing planning and implementation mechanisms.

About the Author

Megan Lewis, AICP, is a project planner with Cardno JFNew and a former APA senior research associate. This article is adapted from a white paper written and published by Cardno JFNew. Authors of that source material include David C. Bier, Futurity; Sam Miller, University of Notre Dame; and Sabina Shaikh, Cardno ENTRIX. In addition to Sabina Shaikh, Cardno JFNew colleagues Rod Ginter and Steve Barker, and Cardno ENTRIX colleague Terry Clark, AICP, provided information on the case studies featured in this article.

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