

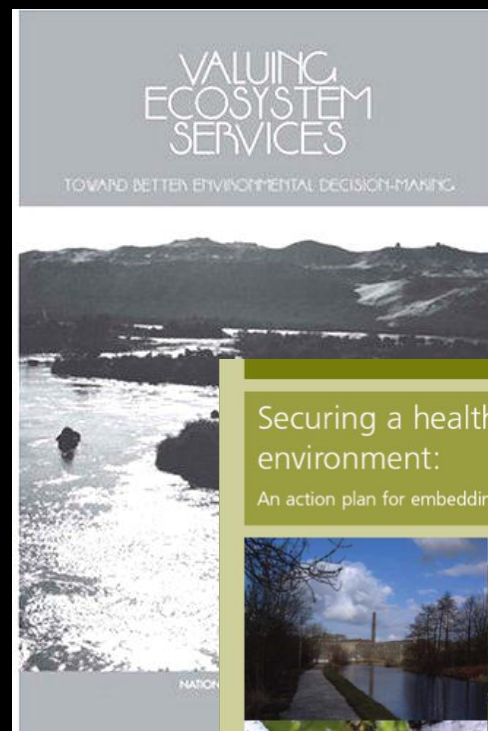
A Demonstration of an Ecosystem Services Valuation Methodology for Reclaimed Phosphate Mined Lands



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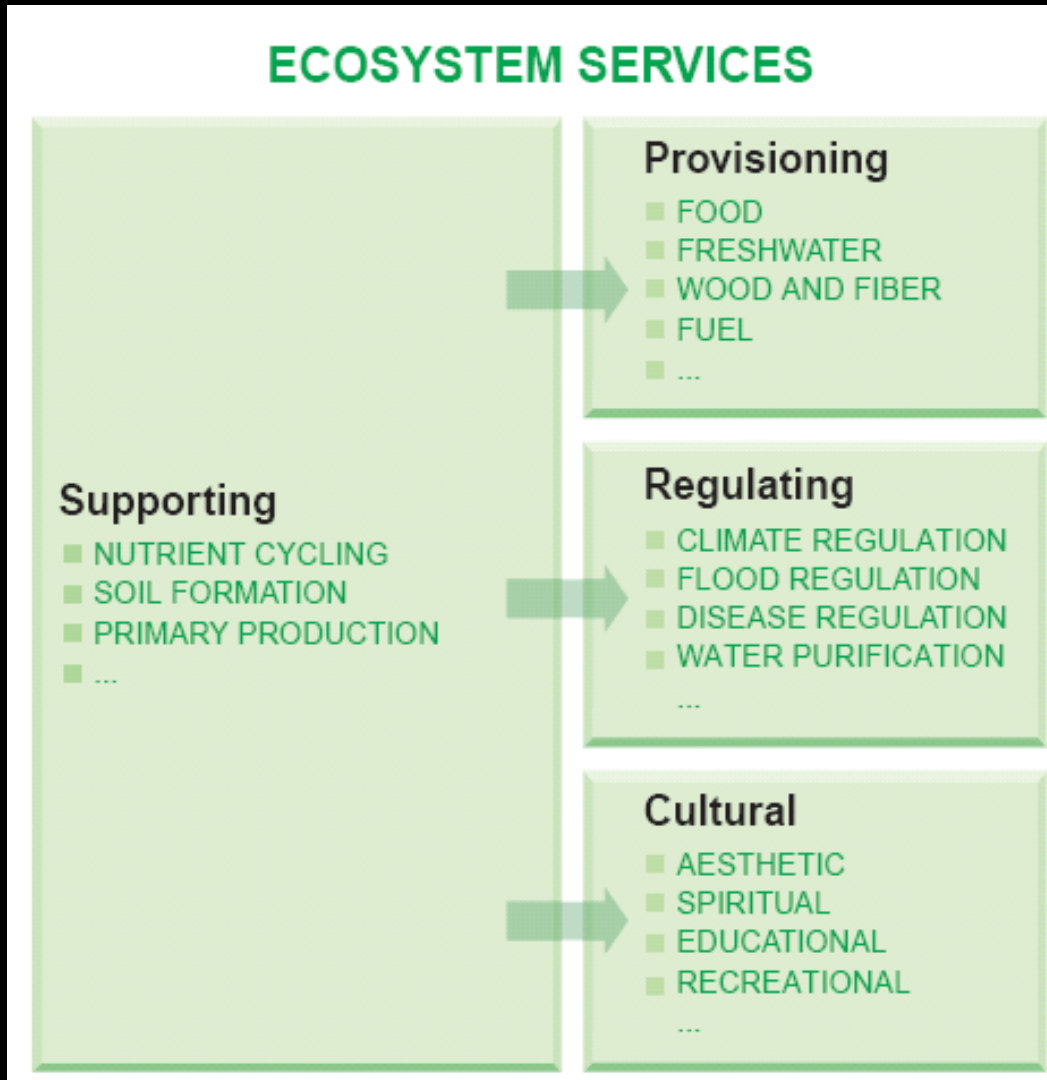
What are Ecosystem Services?

- Ecosystems provide resources and functions that we value
 - Resources & functions are valued because they provide benefits to people in a variety of forms (clean water, habitat for wildlife, aesthetics, timber, recreation opportunities)
- Because we value these benefits, we recognize that ecosystems provide a **service** to people
 - Hence the term “*Ecosystem Services*”

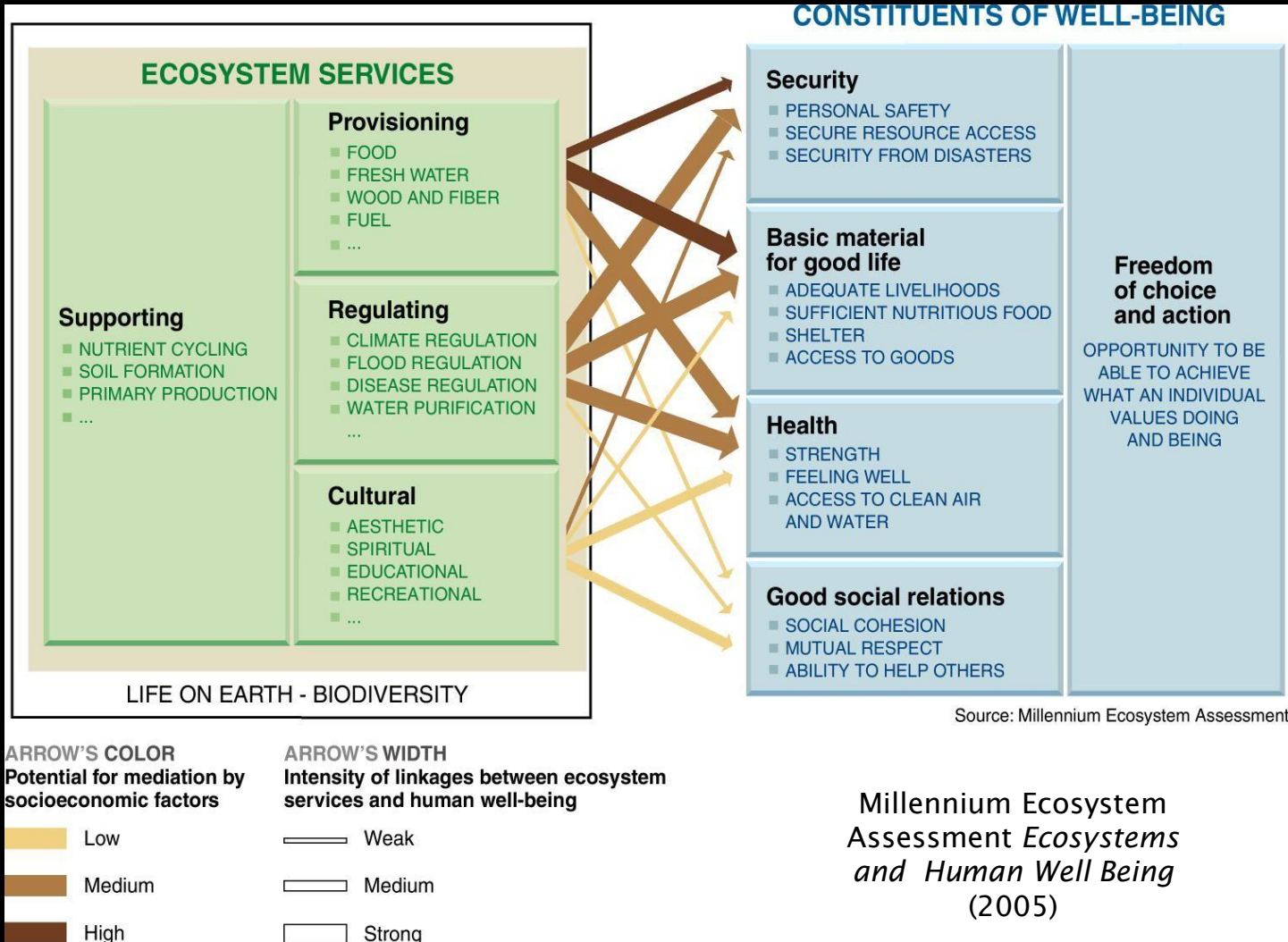


Ecosystem Services: The Benefits People Obtain From Ecosystems

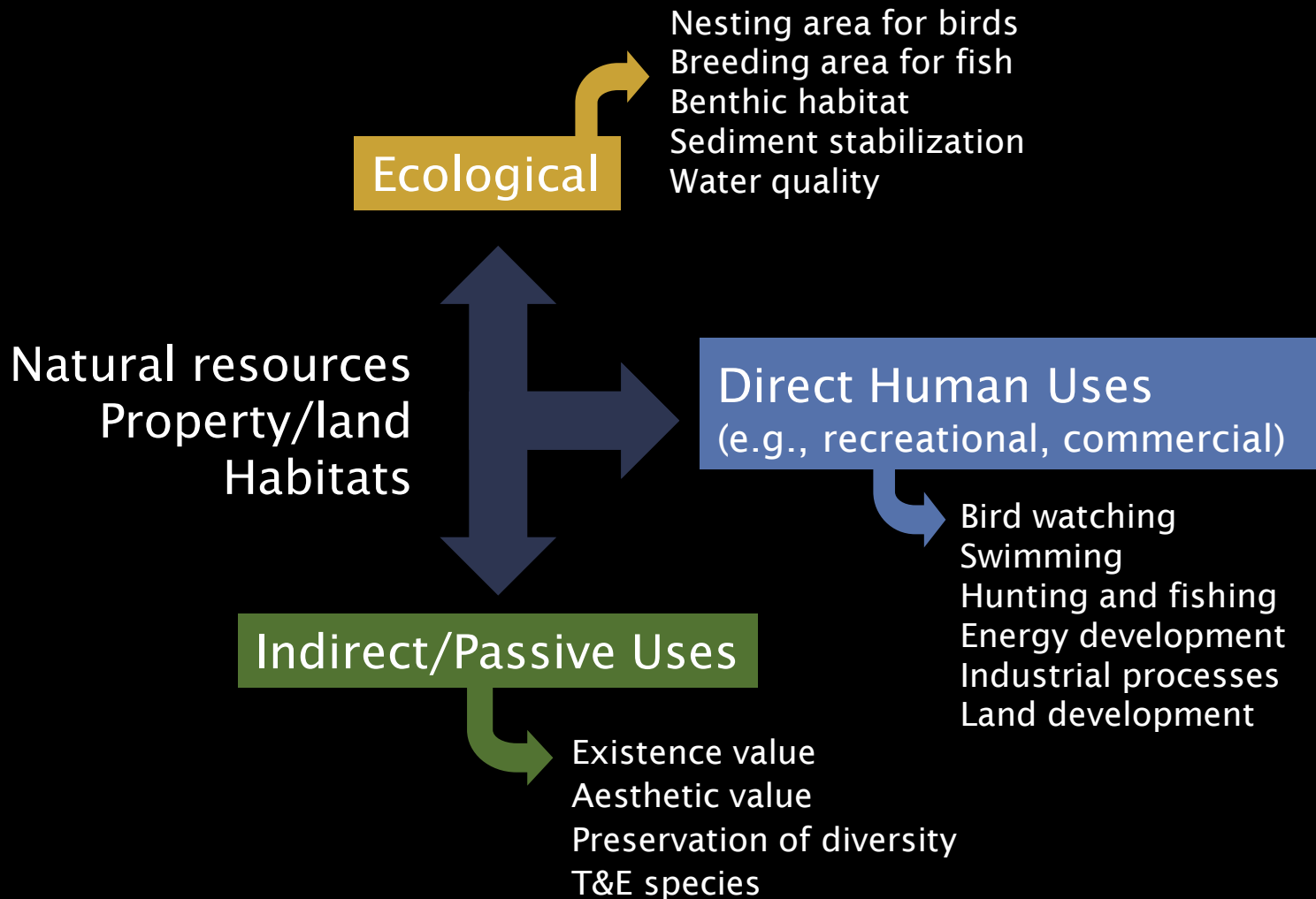
**Millennium
Ecosystem
Assessment
*Ecosystems
and Human
Well Being*
(2005)**



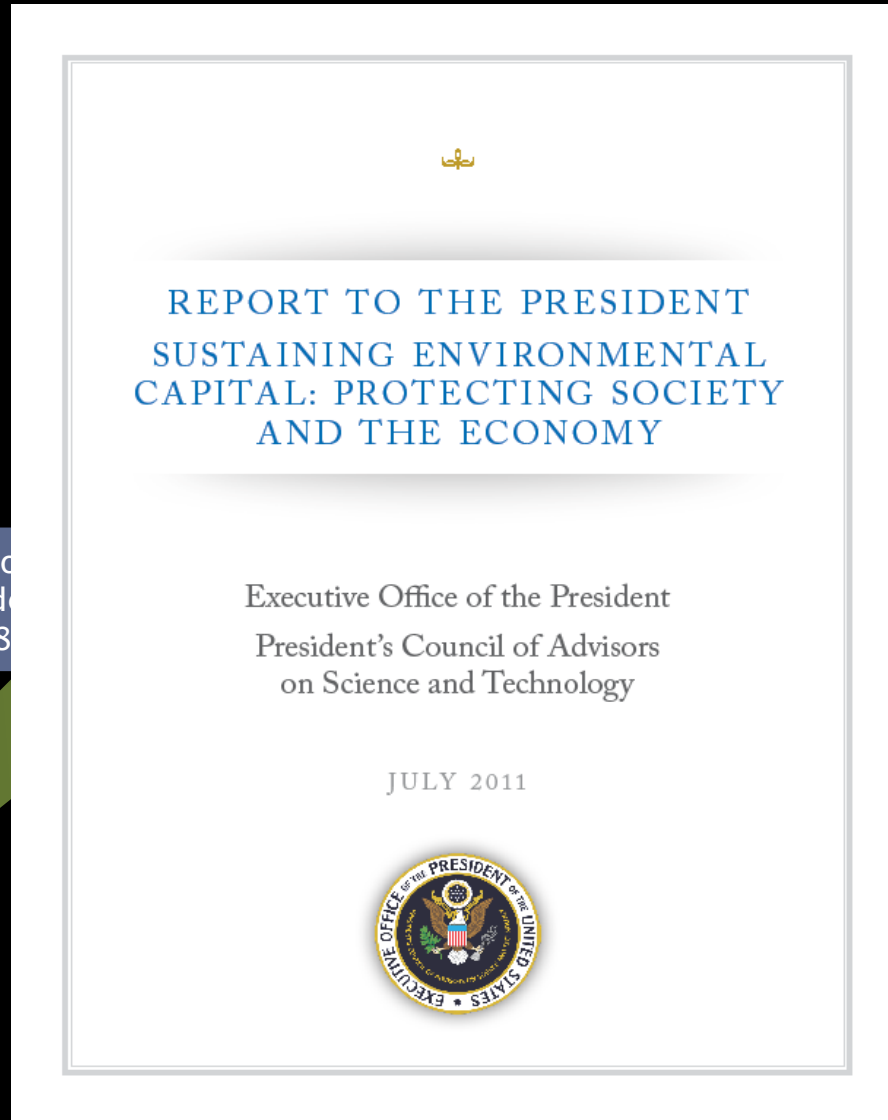
Focus: Consequences of Ecosystem Change for Human Well-Being



Ecosystem Services: Categorization



How Did We Get to Ecosystem Services?



IFC
PS-6
2010-12

Ecosystem
Services

Presidents
/NEA
1

Exxon
Valdez
1989

CERCLA
1980

Money

Why Formal Quantification of Ecosystem Services is Important?



- Enables you to:
 - Document the ecosystem value of a parcel of property
 - Document the ecosystem cost/benefit of an action
 - Compare ecosystem benefits/costs between actions (i.e., NEBA, NESAs)
 - Select/modify actions that maximize ecosystem benefits
- Subsequently, quantified values provide supporting information for decision-makers and other stakeholders

Value of Reclaimed Phosphate Mined Lands

- Reclaimed phosphate mined lands provide valuable ecosystem services, which include:
 - Providing wildlife habitat
 - Providing water recharge areas
 - Providing buffers for aquatic habitats
 - Sequestering carbon
 - Providing wildlife corridors and connectivity to overall ecosystem
 - Providing recreational and fishing opportunities



Value of Reclaimed Phosphate Mined Lands

- Traditional approaches to evaluating and monitoring reclaimed phosphate mined lands typically do not quantify ecosystem services
- We demonstrate a methodology for quantifying ecosystem services for reclaimed phosphate mined lands using two examples



Value of Reclaimed Phosphate Mined Lands



- We use economics based ecological and human use metrics to evaluate the ecosystem services of:
 - Landscape perspective: A portion of the mined landscape in Polk County, Florida
 - Reclaimed lakes



Valuation Approaches



- Use Habitat Equivalency Analysis (HEA) Framework to quantify ecological habitat services
 - Upheld by the United States District Court for the Southern District of Florida as appropriate method to value impact and restoration
- Direct Human Use Methods
 - e.g., benefits transfer (e.g., WTP)

Landscape-Level Example



- Pre-Mined Area in Polk County, Florida in 1968



- Post-Mined Area in Polk County, Florida in 2012



Net Ecosystem Service Analysis



- In this case, compares discounted service flows generated by different patch configurations (i.e., different landscapes).
- Each landscape is considered a different form of natural capital, some configurations provide higher levels of service flows than others.
- The contribution of a patch to landscape services will vary by habitat quality within a patch and its spatial context (i.e., its spatial relationship with other patches).
- When trading patches within a landscape, NESAs incorporate the importance of the spatial context of patches lost and gained.

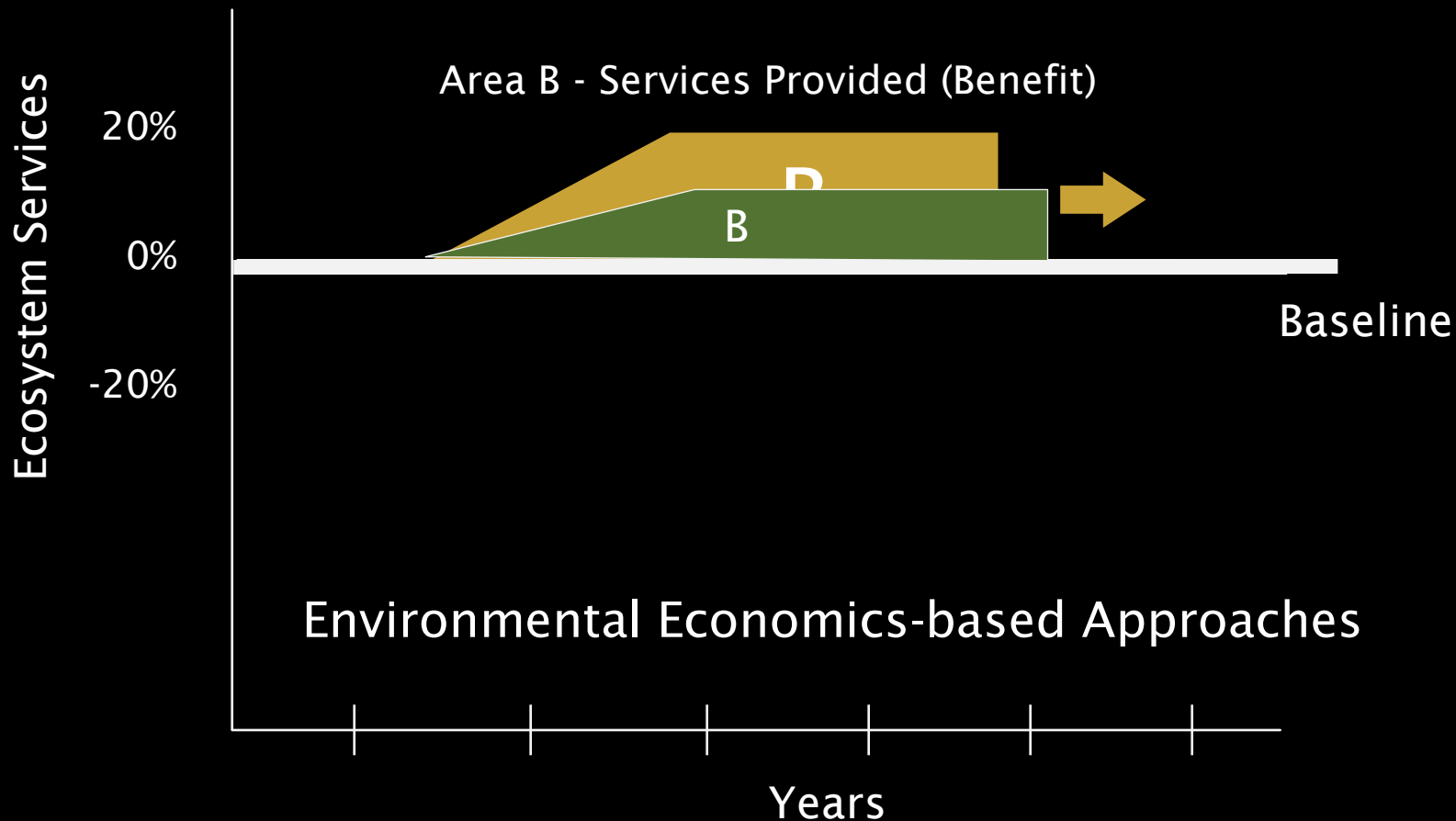
Valuing the Resource



- Increased **Commercial** Value (mining versus agriculture)
- Reclaimed lakes contribute to local economy
 1. Increased **Ecological** Value
 - ✓ Increased quality of habitat: A change from cropland/pasture to aquatic
 2. Increased **Human Use** Value
 - ✓ Significant positive economic and social impact

Quantifying Net Ecosystem Services: Comparing Impacts and Benefits Over Time

Impacts and benefits are based on changes from the baseline (pristine?)



Alternative Comparisons

Example:

Evaluate and compare pre- and post-mined areas

Scenario #1					
Column 1	Column 2	Column 3			
<i>Alternative Management Action</i>	<i>Ecological Services (dSHYs)</i>	<i>Human Use Value (\$ or user days)</i>
Landscape 1					
Landscape 2					
...					
...					

Quantifying Ecosystem Services

- Too many services provided to practically measure all of them
 - Typically select one or more metrics to use as a surrogate to represent services
- Ecological Services metrics
 - Fish density (fish/hectare, fish/km, etc.)
 - Suitable habitat (ha for key species)
 - Water quality (N in mg/L)
 - Soil preservation (erosion rates)
 - Others
- Direct human use services metrics
 - Recreation (bird watching days)
 - Visitor Days (converted to \$)
 - Food production
 - Economic well-being
- Can select specific metrics or combination

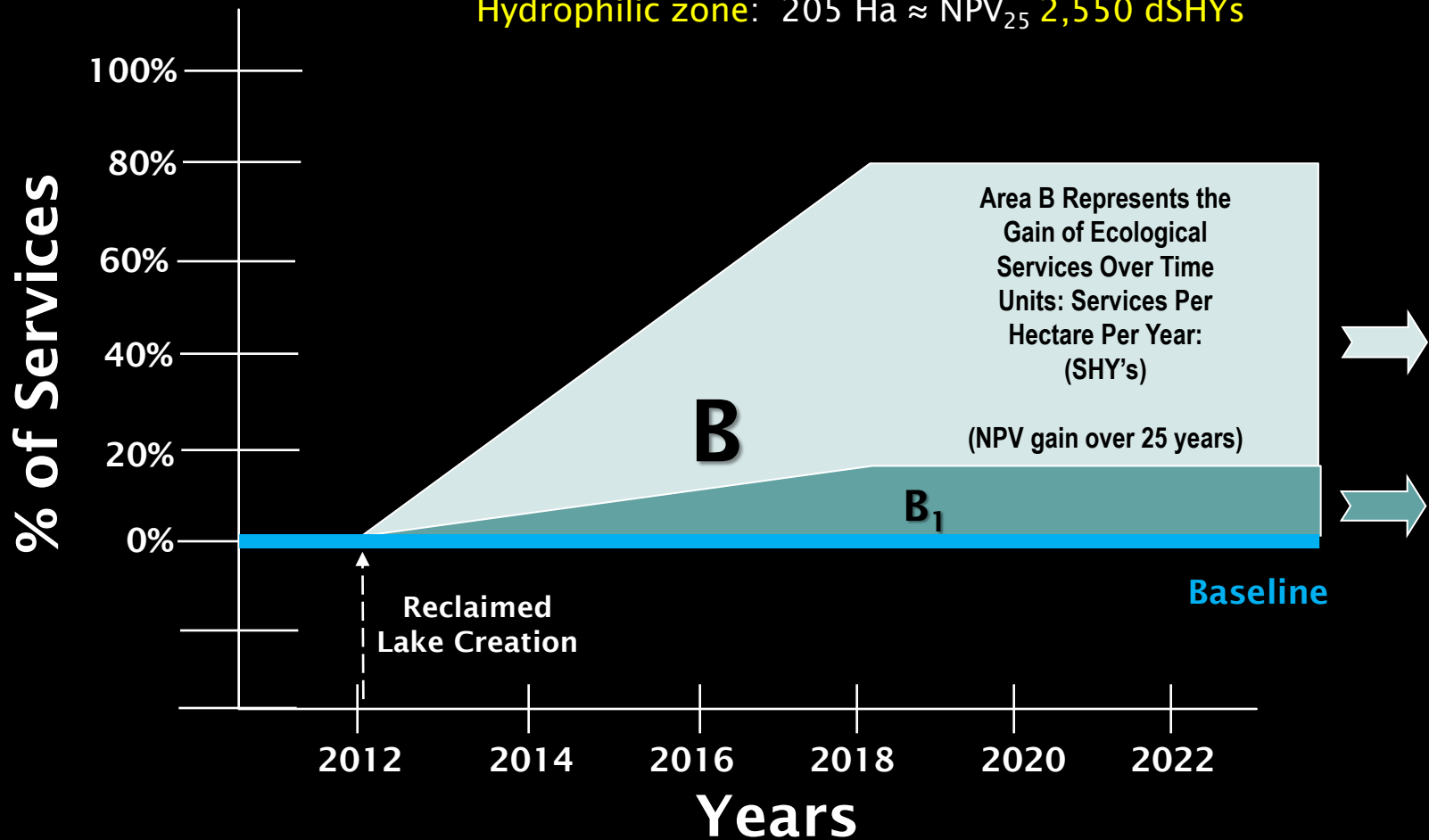


Ecological Services – Polk County Example

Habitat Quality Increase

Lake habitat: 200 Ha \approx NPV₂₅ 2,490 dSHYs

Hydrophilic zone: 205 Ha \approx NPV₂₅ 2,550 dSHYs



Example: Human Use Services - Alafia River State Park (Reclaimed Phosphate Mine)



- **Park Activities**

- Bicycling
- Camping (Equestrian, full facility, Group, Primitive)
- Canoeing and Kayaking
- Fishing
- Hiking/Nature Trail
- Horse/Equestrian Trail
- Pets
- Picnic pavilion
- Picnicking
- Playground
- Restroom facilities
- Showers Day Visitors
- Wildlife Viewing

- **Park Economic Impact**

- ✓ 2010-2011: about 60,000 visitors
- ✓ \$ 2,909,676/year Economic Impact
 - (FL State Parks 2012 data; economic impact is calculated as the amount of new dollars spent in the local economy by non-local park visitors and park operations: expenditures, jobs, etc.)
 - **NPV₂₅ ≈ \$52 Million**
 - **NPV₅₀ ≈ \$77 Million**

- **Net Economic User Value**

- ✓ \$900,000
 - **NPV₂₅ ≈ \$16 Million**
 - **NPV₅₀ ≈ \$24 Million**

Human Use Services - Polk County Example



- **Land Management Area**

- Fishing
- Hunting
- Wildlife Viewing

- **Economic Impact and Net Economic User Value?**

- Visitors? 13,000 since 2001
- 53,000 hours of fishing
 - largemouth bass and crappie
- Fin and Feathers Club, 700 members
- Tilapia harvesting: commercial

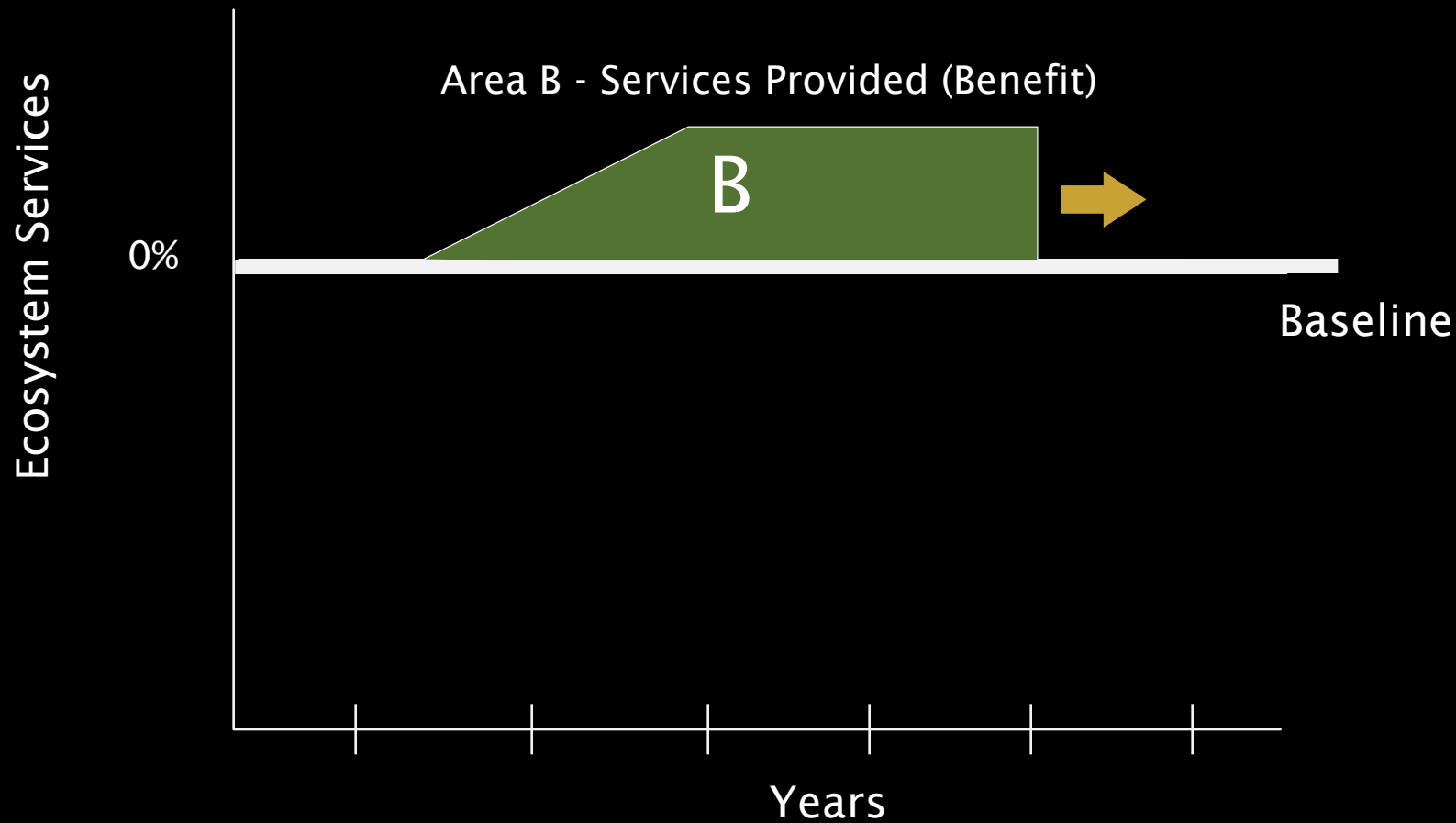
- NPV₂₅ ≈ \$? Million
- NPV₅₀ ≈ \$? Million

Reclaimed Lakes Example



- Lake Vegetation Index (LVI) developed by the FDEP to evaluate the ecological health of a lake
- LVI score ≥ 43 indicates healthy lake
- LVI scores resulting from recent evaluation of **reclaimed** lakes in Central Florida averaged 46 (ranged from 37-53; only 1 was below 43)
- LVI scores resulting from recent evaluation of **natural** lakes in Central Florida averaged 41 (ranged from 0-85)

LVI Data Suggests These Curves are Similar



Reclaimed Lakes Example



- LVI evaluations indicate that reclaimed lakes are ecologically healthy
- Reclaimed lakes used by many bird species
- Reclaimed lakes typically do not have developed shorelines
- Watersheds of reclaimed lakes typically do not include non-point source pollution from residential, commercial, and industrial development (e.g., metals)
- Watersheds of reclaimed lakes typically do not include agricultural runoff (e.g., pesticides, herbicides)



Conclusions

- Reclaimed lakes can offer significant and valuable ecosystem services
- At the landscape-level, reclaimed phosphate mined lands can offer valuable ecosystem services (tens to Hundreds of Millions of \$)



Conclusions

- Ecosystem services offered by reclaimed phosphate mined lands should be considered during the permitting process and development of reclamation plans
 - Balance risks, benefits, and tradeoffs associated with competing alternatives
- Metrics to quantify ecosystem services should be included in monitoring plans of reclaimed lands

Acknowledgements

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