

Ecosystem Services in Decision Making
Scoping Analysis for Island County, Washington



Prepared for Whidbey Environmental Action Network

By

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About Center for Sustainable Economy

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1.0 Purpose

This scoping analysis was prepared for Whidbey Environmental Action Network (WEAN) to identify the components and associated costs for a comprehensive evaluation of ecosystem service values for use in key decision-making processes affecting Island County's lands and waters.

Island County includes Camano, Whidbey and seven mostly uninhabited islands in Puget Sound. Natural capital and ecosystem services are critical to many of its economic sectors. Recreation and tourism drive a significant portion of Island County's local economy by supporting retail trade, lodging, and small businesses anchored by natural landmarks like Deception Pass State Park and Ebey's Landing National Historical Reserve. Throughout the Island, camping, boating, whale watching, hiking, fishing, visiting farm stands and historical sites and attending music, sports, or other cultural events are eco-tourism activities that generate over \$350 million each year in visitor spending and support nearly 2,800 jobs (Dean Runyan Associates, 2022).

Agriculture is another sector that benefits from intact natural areas that supply pollinators, water, control of pests and other ecosystem services. According to the most recent Census of Agriculture, Island County supports 377 farms selling goods worth over \$23 million each year.¹ The retirement sector, representing nearly 30% of the population is heavily dependent on high-quality living environments with clean air, clean water, and opportunities to view, study, and appreciate ecologically significant areas.

¹ USDA Census of Agriculture, 2022. Island County. Available online at: <https://www.edcislandcounty.org/assets/pdf/2022+Island+County+Agriculture+Census/>.

However, like much of western Washington, Island County is experiencing increased pressure to develop to accommodate population growth and new industries, which is causing a significant loss of natural areas every year. Development pressure is driving a significant risk of agricultural and forestland conversion into residential or commercial uses. To combat this, the county passed its Island County Comprehensive Plan Update to implement stricter zoning protections, enforce "no-net-loss" ecosystem policies, and leverage specialized current-use tax incentive programs.

Having reliable ecosystem service values for use in these and other permitting and land use decisions is important for ensuring that such development unfolds in a manner that minimizes the loss of valuable natural resources and mitigates for that loss to the maximum extent practicable.² Ecosystem service values are also critical in weighing the public benefits and costs of investments in protecting and restoring natural areas.

This analysis reviews the basic concept of ecosystem services, methods for quantification, opportunities for use of values in Island County decision making, past work, and gaps in that work. It then concludes with a preliminary cost assessment of additional work needed to fill those gaps in order for Island County to have defensible figures for use in several major decision-making processes and to support benefit-cost analysis of investments in ecosystem restoration and protected areas. The analysis presents information from a desktop review of publicly available information conducted over a four-week period and so may omit information not readily available from these sources.

2.0: What are ecosystem services? Concept and basic typology.

2.1 Concept and history

At its most basic level, the concept of ecosystem services means the vast array of benefits we receive from natural areas and species with whom we share the planet. The assemblages of plants, wildlife, fish, microbes, bacteria and other species in habitats ranging from windswept dunes to temperate and tropical rainforests support humanity by providing services essential to perpetuation of the species. These range from the wild foods, medicines, fish and game many subsist on to the information needed for biomimicry with technologies that replicate ecosystem functions and processes (Zari and Hecht, 2020).

² For example, under the Island County Code (ICC 17.05A.100 and ICC 17.02B.500), any permitted or exempt development along shorelines or critical areas must identify and mitigate environmental impacts so there is no net reduction in ecological functions, values, or processes.

While the concept of nature providing services essential to humanity has a long history, it was not until the seminal work of Daily (1997), Costanza et al. (1997) and others in that era who first highlighted the economic importance of ecosystem services and argued for inclusion of natural capital and ecosystem service in economic performance metrics and public decision making since they have economic values that could be quantified with well-developed methods.

Costanza et al. (1997) estimated that the world's ecosystem services provided at least \$33 trillion in value each year. Using the same methods as in the 1997 paper but with updated data, Costanza et al. (2014) estimated the value of global ecosystem services to be \$125 – \$145 trillion/yr. Global studies like these have helped inspire a rapidly growing set of research that quantifies ecosystem service at many scales, including states, counties, cities. A comprehensive database of such studies currently has over 2,000 entries.³

2.2 Basic typology

In 2001, an international coalition of over 1,360 scientists and experts from the United Nations Environmental Program, the World Bank and the World Resources Institute initiated an assessment of the effects of ecosystem change on human well-being. That effort resulted in the landmark Millenium Ecosystem Assessment (MEA), which created a standard typology used in most ecosystem service valuation studies today (MEA, 2003). That study classified ecosystem services into four broad categories according to how they contribute to human well-being. FEMA (2022) describes these categories as:

- **Provisioning Services** provide the physical materials that economies and communities use. Community gardens grow food. Rivers provide drinking water, as well as fish for food.
- **Regulating Services** are benefits obtained from ecosystem processes. Intact ecosystems provide regulation of climate, water quality/supply and soil erosion control. They also keep disease organisms in check.
- **Supporting Services** refer to the habitats which support food webs and all life on the planet.

³ The Ecosystem Services Valuation Database is available online at: <https://www.esvd.net>.

- **Information Services** allow humans to interact meaningfully with nature. These services include providing spiritually significant species and natural areas, natural places for recreation and opportunities for scientific research and education.⁴

A detailed presentation of these categories with examples are included in Table 1, adapted from Cousins et al. (2020) and FEMA (2022).

3.0: Methods for quantifying ecosystem services.

Batker et al. (2008) and FEMA (2022) provide useful overviews of ecosystem service valuation methods. Table 2 is adapted from these studies. Primary studies fall into three distinct categories: (1) direct market valuation; (2) revealed preference approaches, and (3) stated preference approaches.

Direct market valuation is the easiest since it involves prices of goods and services that have market price data available. Examples include the value of fish sold on open markets, the cost to replace water quality filtration performed by an intact watershed with a filtration facility, or the flooding costs avoided when a wetland is restored. Revealed preference approaches are those that infer ecosystem service values from people's activities, such as the money spent traveling to watch birds or the premium paid for housing adjacent to a natural area. Stated preference approaches use surveys to ask people directly what they would be willing to pay to protect a resource or which discrete bundle of environmental goods they would choose at different levels of provision and cost.

Primary valuation studies are often too expensive for use in policy settings with limited public funds available for planning and analysis. An alternative approach is what is known as benefits or value transfer. The benefit transfer method takes estimates from different study sites and applies them to the site of interest after adjusting for local factors. So, for example, if Island County wanted to use benefits transfer to place a per acre value on its generic category of 'forestry' lands, updated state trust land values from Cousins et al. (2020) could be used to derive a weighted average based on Island County acreages of each of the seven forest types valued in the 2020 study.

⁴ More recent typologies reclassify information services as cultural services, defined as "Cultural services now encompass all non-material benefits—including spiritual enrichment, recreation, aesthetic experiences, and cognitive systems—expanding beyond just the "information" or "education" aspect.

4.0: Relevance to Island County permitting and land use decisions.

Having current and defensible values for ecosystem services can play an important role in making land use and planning decisions in Island County more efficient and comprehensive in the range of benefits and costs considered. The following decision-making processes are illustrative, but not exhaustive:

4.1 No-net-loss

As mentioned above (note 2) the Island County Code contains no-net-loss standards for shorelines and critical areas. In particular, any permitted or exempt development along shorelines or critical areas must identify and mitigate environmental impacts so there is no net reduction in ecological functions, values, or processes (ICC 17.05A.100 and ICC 17.02B.500). Ecosystem service values can serve as the basis for this required mitigation to ensure that critical areas or shorelines with a relatively lower values are not used as mitigation against projects that impact high-value parcels.

4.2 Justification for investments in natural areas

Investments in acquisition of lands for parks or protected areas or in ecological restoration activities are ready-made settings for ecosystem service values since they provide the basis for comparing the long-term benefits of such investments against their financial costs. For example, as noted in the most recent Island County natural areas newsletter, Island County commissioners approved \$315,000 to the Whidbey Camano Land Trust for acquiring Dragonfly Glades as an addition to Trillium Community Forest, alongside over \$200,000 for ongoing park and land maintenance.⁵ Having ecosystem service values on hand could be used to help justify such expenditures by incorporating the expected ecosystem service value stream over a specified time frame, such as 100 years.

4.3 Public benefit rating system

The State Open Space Tax Act, Chapter 84.34 RCW, provides an opportunity for landowners to apply for a reduction in property taxes for certain categories of open space, agricultural, and timber lands. This tax reduction is based upon a current use assessment (CUA) of the land rather than on the traditional fair market value system of "highest and best use."

⁵ Island County, 2026. Natural Resources Newsletter, July 2026. Available online at: <https://content.govdelivery.com/accounts/WACOISLAND/bulletins/41e4ee6>.

Designated forest and farmlands maintained for commercial production enjoy property tax benefits as great as 99% under this program,⁶ but there is interest in extending the incentive to encompass non-consumptive uses and non-market benefits to “assure the use and enjoyment of natural resources and scenic beauty for the economic and social well-being of the county and its citizens.”⁷

The Island County Public Benefit Open Space Rating System (PBRs) serves this purpose by establishing an application process that assigns parcel scores and levels of exemption from assessed values. The scoring system assigns zero exemption (i.e. tax on 100% of assessed value) for parcels that score 4 points or less and a 90% reduction (tax on 10% of assessed value) for parcels that score 40 points or better.⁸ There is interest in reforming this system to move properties from the designated forest and farm program – which requires continuous commercial production – to the PBRs program thereby granting similar property tax reduction to owners who wish to maintain their lands in natural condition.⁹ A code amendment was formally proposed in late August 2026.¹⁰

A comprehensive ecosystem service valuation can inform this program in at least two important ways. First, it will provide an estimate of the economic benefit for each increment of property tax reduction associated with each parcel approved under the PBRs program. Applications that create net benefits (ecosystem service flows exceed property tax losses) can be distinguished from those that result in net costs to the county. This is directly on point to the rules for application review: “the county shall consider whether or not preservation of the current use of the land, when balanced against the resulting revenue loss or tax shift from granting the application under the provisions of this chapter will... [a]ffect any other factors relevant in weighing benefits to the general welfare or preserving the current use of the property as delineated in this chapter.”¹¹

Secondly, it can inform redesign of the rating system. The rating system can be modified to include ecosystem service values past a certain threshold (i.e. \$1 million over 50 years) as a criterion for granting “bonus” points for an application.¹² Importantly, properties that are

⁶ WAC 458-30-200(2)n, tt.

⁷ Island County Code at 3.40.020(A).

⁸ Island County Code at 3.40.040.

⁹ Island County Planning and Community Development, July 2026. Public Benefit Rating System (PBRs) Code Update Recommendation. Available online at: <https://www.islandcountywa.gov/AgendaCenter/ViewFile/Agenda/07152026-1204>.

¹⁰ See: <https://www.islandcountywa.gov/212/Public-Notices#docaccess-8b598442f97f7d7227eff925de70c7f4>.

¹¹ Island County Code 3.40.100.

¹² Island County Code at 3.40.030(D).

proposed for transfer from the designated forest or farm program to PBRS can include avoided costs (i.e. the value of GHG emissions or other forms of pollution avoided from commercial operations) as a component of the ecosystem services protected/restored.¹³ For example, Talberth and Wysham (2026) calculated the avoided costs of carbon emissions associated with protecting one acre of structurally complex older forest from logging to be over \$124,000 at a social cost of carbon of \$262 per metric ton CO₂.

4.4. Conservation Futures prioritization

Island County's Comprehensive Plan identifies that unique or distinctive lands may be preserved in recognition of the irreplaceable character of such resources and of their importance to the quality of life of residents and visitors to Island County. The Conservation Futures Program is an important source of funding to achieve those goals. Funds are derived from a levy on property taxes not to exceed 6.25 cents per \$1000 of assessed value of all taxable property.¹⁴ The Conservation Futures Program is a competitive annual grant with proposed projects reviewed and ranked by a Citizens Advisory Board and County Staff.

In November of 2024, the County adopted resolution a resolution addressing program procedures and evaluation criteria established by a citizen's advisory board.¹⁵ The evaluation criterion are divided into six distinct thematic areas: (a) ecological systems; (b) agriculture; (c) forestry; (d) alignment and leverage; (e) risks of not funding, and (f) stewardship, management, and maintenance. Ecosystem services in the form of food provision, cultural uses, hazard mitigation, water supply, recreation, carbon sequestration, climate change mitigation are identified as important factors within these broad thematic areas.

As such, a comprehensive evaluation of ecosystem services can play an important role in establishing priorities for acquisition of lands under this program. Parcels that score higher in terms of expected ecosystem service flows from services identified within the thematic areas (i.e. food provision, groundwater protection and carbon sequestration) could be ranked higher in terms of the acquisition timeline and use of scarce Conservation Futures program funding relative to parcels that have lower expected ecosystem service values.

¹³ Avoided costs is one of the valuation methods listed in Table 2. Talberth and Wysham (2026) found that one acre of primary forest logging avoided could generate over

¹⁴ RCW 84.34.230.

¹⁵ Island County Board of County Commissioners, 2024. Resolution C-58-24.

4.5 Comprehensive planning – economic development

Island County’s Comprehensive Plan recognizes that natural areas are not just resources to be managed, but “vital assets that provide ecosystem services, recreation, and climate resilience for current and future residents.”¹⁶ The protection and restoration of ecosystem services is thus an important component of a sustainable Island County economy. Because of this, the County has included an economic study of ecosystem services as one of the items to be completed under the plan’s economic development component.¹⁷ The current timing for initiation of that study is 2028.

4.6 Aquifer protection

All of Island County has been designated as a Critical Aquifer Recharge Area since the U S Environmental Protection Agency designated Island County with “sole source aquifer” status in 1982.¹⁸ This means that a majority of the population relies on aquifers as the main source of drinking water. It also means that contamination of the aquifers would create a public health hazard.

Rainwater infiltration is the only source for regenerating the water supply available in aquifers and also serves to prevent sea water from entering the aquifer. As such, water supply is one of the most important ecosystem service of forests, wetlands, and open space. A targeted ecosystem service valuation study could be useful here not only to assign a cost to development of aquifer recharge areas but as a way to justify investments in one or more strategies to maintain aquifers in the face of climate change. The Comprehensive Plan identifies these strategies as smart irrigation, stormwater management, preventative maintenance, retention of forest cover, water conservation and wastewater reuse, plant selection, and landscape management.¹⁹

In terms of methods, replacement cost is probably the best fit. A replacement cost study would assign water supply values per acre for all types of open space based on what it would cost to replace natural rainfall infiltration with technological substitutes such as comprehensive rainfall harvesting above ground, seawater desalinization, or other technically feasible approaches. As a precursor to this study, detailed infiltration rates would have to be established for each type of open space based on monitoring data.

¹⁶ Island County Comprehensive Plan at page 101, section 6.1.1.

¹⁷ Island County Comprehensive Plan at page 591.

¹⁸ Island County Comprehensive Plan at pages 31-32, section 6.2.3.

¹⁹ Island County Comprehensive Plan at page 6, section CL 3.4.

5.0: Previous work, limitations, and gaps

Three ecosystem service valuation studies of relevance to Island County were reviewed in this report and summarized below. These three may not be the only relevant studies, but ones that were accessible and on-point for this scoping analysis. Each could serve as the basis for a benefits transfer component to a more comprehensive valuation study for Island County. In particular, values from these studies can serve as a ‘starting point’ in the comprehensive valuation project, with subsequent steps filling in gaps. Section 6 provides more details on this staged approach. Tables 3, 4, and 5 present values from these studies updated to 2026 dollars.

5.1 Cousins et al., 2020 – state trust lands performance assessment

This report presents an estimate of the total annual non-market economic value generated by nearly 5.2 million acres of trust lands in Washington State, primarily managed by the Department of Natural Resources (DNR). These lands include forests, agricultural lands, grazing lands, and other smaller land use types.

The valuation report was part of a larger assessment of how well the state trust lands are performing from an economic standpoint. The non-market value of the bulk of ecosystem services—except carbon storage and recreation—are measured using a valuation approach that combines geospatial analysis with the benefit transfer method. Carbon storage values were calculated using carbon storage inventories from DNR combined with a 2015 social cost of carbon estimate of \$130.76 per metric ton of carbon (in 2018\$). Recreation values were calculated by combining visitor use data from DNR for 21 recreation activities with consumer surplus values for each activity from a recreational use valuation database maintained by Oregon State University researchers for this purpose (Rosenberger et al., 2017).

Seventeen land cover types and thirteen ecosystem services were included in the study (Table 3). On a per acre basis, the most important contributions come from wetlands in agricultural border areas (\$38,838 per acre per year), urban wetlands (\$14,089 per acre per year), and grassland buffers (\$6,953 per acre per year). In terms of total value, rural forests were by far the most important category (\$1.2 billion per year) followed by upland forests (\$375 million per year) and wetlands outside of agricultural areas (\$97 million per year). Across all ecosystem types, the study concluded that state trust lands provide nearly \$1.9 billion in ecosystem services each year (2026\$). Important gaps include the range of ecosystem services considered (i.e. 13 out of at least 23 total), inability to address

increases in value as scarcity increases, and inclusion of values from past studies that are perceived by some as incomplete or inaccurate.²⁰

5.2 Batker et al., 2008 – Puget Sound ecosystem services

This study presents the results of the most comprehensive valuation of ecosystem services in Puget Sound to date. It was updated in 2010 incorporating values for snowpack and medicinal plants, but these were insignificant and did not change the results or other values used in the original 2008 study (Batker et al., 2010). The study utilized geographic information system data to categorize ecosystems into fifteen types: mid succession forests, late to old growth forests, riparian forests, riparian shrub, freshwater wetlands, grasslands, agricultural lands, pasture, rivers and lakes, urban greenspace, beach, estuary, salt marsh, eel grass beds, and marine waters. Peer reviewed primary valuation journal articles were used to peg the low and high values per acre for some ecosystem services in each of the vegetation types. Ecosystem services valued include gas and climate regulation, disturbance regulation, water flow regulation, water quality, water supply, habitat, pollination, soil and erosion control, soil formation, biological control, nutrient cycling, and aesthetic and recreational value.

While this study stands as the most comprehensive valuation to date, it is also incomplete. Of the 23 identified categories of ecosystem services, only 12 could be valued and of these 12, none were fully valued across all ecosystem types. This partial valuation exercise estimated that the fifteen ecosystem types generate ecosystem service values that range from \$12 to \$102 billion per year (Table 4). The most significant ecosystems and ecosystem services valued include beaches (\$37,000 - \$135,000 per acre per year), freshwater wetlands (\$11,000 - \$99,000 per acre per year), and eel grass beds (\$9,000 - \$25,000 per acre per year).

5.3 FEMA, 2022 – ecosystem service values in hazard mitigation programs

The Federal Emergency Management Agency (FEMA) provides billions of dollars each year to communities through its Hazard Mitigation Assistance (HMA) programs to reduce or eliminate long-term risk from natural disasters. This includes grants through the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC) and Flood Mitigation Assistance (FMA). FEMA also provides hazard mitigation funding through the Public Assistance (PA) program, sometimes referred to as 406 Hazard

²⁰ See Appendix A: Ecosystem Service Valuation Limitations, for a more complete summary of these issues.

Mitigation. Recently, Island County received support for its multi-jurisdictional hazard mitigation plan, which was updated over an 11-month period in 2019 and 2020.²¹ FEMA requires that hazard mitigation projects be cost-effective to the federal government; therefore, the project must demonstrate a Benefit-Cost Analysis (BCA) that compares the net present value of a project's future benefits and costs.

In recent years, FEMA began to recognize and emphasize the value of investing in Nature-Based Solutions (NBS) for mitigating the impacts of floods, wildfires, droughts and other natural hazards. Economic studies have shown that NBS can often be more cost-effective than traditional, man-made solutions, such as levees or seawalls, while providing multiple community and environmental benefits. Ecosystem services are an important benefit of hazard mitigation projects that incorporate NBS, and they also establish hazard mitigation approaches that are not considered NBS, per se (e.g., acquisition and relocation can improve floodplain health in the footprint of the removed structures).

To help justify NBSs, FEMA Ecosystem Service Values (ESVs) allow local governments to monetize the environmental benefits of nature-based solutions—such as flood reduction, water purification, and carbon sequestration—directly within hazard mitigation planning. Measured in dollars per acre per year (\$/ac/yr), these values are integrated into FEMA's Benefit-Cost Analysis (BCA) Toolkit to help communities justify funding for resilient infrastructure.

Table 5 provides the ecosystem service values FEMA provides for use in justifying grants made through each of its hazard mitigation programs. Per-acre values are presented for nine land cover types and fourteen ecosystem services and reflect 2021 values updated to 2026 dollars. According to this analysis, beaches and dunes are by far the most valuable land cover with ecosystem services valued at over \$370,000 per acre per year from just two services – aesthetic value and recreation. Riparian zones, urban open space, and forests are the next most important land cover types with respective annual ecosystem service values of \$45,842, \$19,151 and \$15,515 per acre per year. Key limitations identified include the need to downscale any of the national values reported to local areas and many “missing” ecosystem service values for each of the land cover categories.²²

²¹ Island County Department of Emergency Management, 2020. Island County Hazard Mitigation Plan. Available online at: <https://www.islandcountywa.gov/539/Island-County-Multi-Jurisdictional-Hazar>.

²² In Table 5, a zero figure does not mean that a particular land cover type does not provide that service, just that there are no credible estimates available.

6.0 Components, costs, and timing of a comprehensive assessment

In order to have on hand reliable and up to date ecosystem service values to support decision making, Island County could commission a comprehensive assessment that makes maximum use of currently available information presented in Tables 3, 4 and 5, fills in important gaps with primary studies, and then demonstrates how the resulting values can be used in practical applications such as the public benefit rating system program or the no-net-loss policy for critical resource areas and shoreline ecosystems. Find below a brief description of key components and a preliminary budget:

6.1 Consistent ecosystem typology

The first important step in the comprehensive assessment is the selection of ecosystem types to value. This presents a challenge because ecosystem service valuation studies often use completely different schemes and those, in turn, may not be suitable for particular decision-making processes. For example, Table 6 presents the ecosystem types valued across the three studies reviewed above, the scheme used by Nature Serve (2009), as well as Island County's schemes used for classifying critical areas and natural lands. The schemes used are widely divergent.

For example, with respect to forests, Island County uses one broad category called 'forestry' for natural lands while Nature Serve's classification for Puget Sound contains nine distinct entries. Cousins et al. (2020) uses seven categories, largely based on general location (i.e. 'rural'), while Batker et al. (2008) estimates values for five forest types distinguished by general location and age class. A geographic information system analysis would be needed to crosswalk these schemes into one consistent scheme used in multiple Island County planning and land use settings, estimate acreages in each, and then create spatially explicit maps that can pull up precise ecosystem types for any parcel or group of parcels of interest.

6.2 Benefits transfer

The second step in a comprehensive valuation for Island County would be to incorporate ecosystem service values from relevant published studies in accordance with the benefits-transfer methodology discussed in Section 3.0. Each of the three studies reviewed in the previous section could be used, as well as others that may exist and are accessible through

the Foundation for Sustainable Development's Ecosystem Services Valuation Database²³ and other open sources.

As discussed in Section 3, the task can be somewhat complicated when values for one service from previous work in a different location are largely dictated by local economic or environmental factors that would need to be adjusted to be accurate at the location of interest. One example is the information (cultural) service of aesthetic value (i.e. scenery) derived from hedonic pricing models that tease out the price premium placed on properties adjacent to protected areas. Because prices for similar dwellings differ greatly between markets, it may be necessary to adjust values transferred up or down depending upon the strength or weakness of housing demand in the original study area relative to the area of interest. Another example is the value of carbon sequestration. Forests, grasslands, or wetlands in the original study area may have significantly greater or lower rates of annual carbon uptake and so the resulting per-acre values would need to be adjusted.

6.3 Primary valuation studies

As previously discussed, ecosystem service values from previous studies are incomplete. For example, Batker et al. (2008) noted that of the 23 identified categories of ecosystem services, only 12 could be valued and of these 12, none were fully valued across all ecosystem types. Likewise, the zero-dollar figures in Table 5 (FEMA, 2022) do not mean that there are no ecosystem service values in these categories but that credible studies to fill in these gaps are not presently available. As such, the next important step in a comprehensive ecosystem service valuation for Island County would be to commission primary studies that fill in key gaps.

Water supply (i.e. the value of aquifer recharge), carbon sequestration, and the aesthetic value of forest and agricultural land protected from commercial use are three examples that may be priorities for Island County. For water and carbon, a combination of biophysical modeling and sampling would need to inform the research. Aquifer infiltration rates and above ground carbon sequestration by ecosystem type are examples of measurements that would be gathered on a statistically significant sample of locations pertinent to Island County land use decisions to supplement the use of standard models and data sources like the Forest Inventory and Analysis (FIA) program of the USDA Forest

²³ See note 3. The ESVD currently has 310 entries under temperate rain or evergreen forest, and 86 entries for coastal dunes and cliffs, two ecozones that are relevant to Island County.

Service²⁴ or aquifer recharge models recommended by USGS.²⁵ For aesthetic values, original contingent valuation surveys of a statistically significant proportion of households (about 37,000 in Island County) would be ideal. The survey instrument would ask respondents' willingness to pay for the added layer of protection offered through the PBRs program relative to the designated farm or forestland programs and thus be far more accurate than walking in values from surveys in other regions.

6.4 Policy applications and research questions

To demonstrate the proper use of ecosystem service values, the comprehensive report could contain a section discussing examples in each of the policy settings discussed in Section 4 – public investments in natural areas, no-net-loss, the public benefit rating system, Conservation Futures prioritization, comprehensive planning, and aquifer protection. For example, the assessment could generate a “values at risk” estimate by using benefits transfer to assign ecosystem service values to all properties now at high risk of land use conversion. Values from Batker et al. (2008) and Cousins et al. (2020) would be most suitable for this exercise.

In addition, there are specific questions about land use tradeoffs that can be informed by the comprehensive valuation. For example:

- What is the value of carbon stocks and annual carbon sequestration for each Island County ecosystem type compared with the value of property taxes collected if they were developed?
- What is the value of avoided stormwater and flooding costs from protected natural areas?
- What is the value of the aquifer recharge services provided by natural and critical areas?
- What is the consumer surplus value of recreation on county owned and conserved lands?
- What is the value of avoided logging damages from switching forest parcels from the designated farm and forestland program to the PBRs?

²⁴ EVALIDator is a USDA FIA tool for extracting carbon sequestration and storage rates for each ecoregion, state, and county. Available online at: <https://apps.fs.usda.gov/fiadb-api/evalidator>.

²⁵ See, e.g. USGS, Description of Recharge Estimation Techniques. Available online at: <https://pubs.usgs.gov/sir/2007/5038/section3.html>.

To be most useful, the comprehensive assessment could include a subsection devoted to answering one or more of these.

Completing each of these research components will ensure that ecosystem service values Island County uses in one or more of the decision-making process described above will represent the best available science and generate values that are reliable, accurate, verifiable, and legally defensible. For example, updating and supplementing values from previous work via benefits transfer will ensure that such values reflect current prices and include important ecosystem services excluded from the original studies.

6.5 Preliminary budget

The greatest expenditure by far for an Island County comprehensive ecosystem service valuation is personnel. If the study duration is set for one year, at least 2.5 FTE positions would be required: a senior economist (to provide overall coordination and assign economic values), a geographic information systems (GIS) specialist, and a biophysical modeler (carbon, aquifer recharge, sea level rise, etc.). One of the latter two positions could be 0.5 FTE depending on the choice of methods. A ballpark estimate for these positions for one year is \$240,000.

For primary studies, there will also be a significant travel component. Field visits for each biophysical modeling task would be required, and depending on format, additional field visits to communities would be required to conduct in-person contingent valuation surveys. Without a more detailed scope of work, a precise estimate for travel is difficult to estimate. Nonetheless, \$20,000 is probably a good placeholder.

Information and software purchases may also be necessary. Not all GIS layers are open access, so it may be necessary to purchase from proprietary sources. The team may also need to purchase modeling software for carbon, water, and contingent valuation data (i.e. Stata or R). The total cost here will probably not exceed \$15,000.

Project overhead is typically less than 30% of a study like this that will be almost exclusively completed by outside contractors. However, for non-profits like CSE best practice is to keep such costs at no more than 10%. This would add about \$28,000 and result in an overall cost of about \$303,000 for the comprehensive evaluation if CSE took the lead role.

If this level of funding is not available, there are interim products that could be produced at a lower level of investment. One option is to limit the analysis to just the benefits transfer component, which would reduce the FTE requirement to roughly 1.0 (part-time economist and part-time GIS specialist), eliminate the need for field visits and gathering of data for primary analyses, and reduce information, software and overhead costs. This parsimonious approach should cost no more than \$120,000.

Another option is to focus the study on just one important service – say aquifer recharge values for the various land cover types – greatly reducing the scope of the benefits transfer exercise. This would result in a lower time commitment from the economist but increase it somewhat for the GIS and fieldwork relative to the second option. Overall, this should keep costs to \$80,000 or less.

7.0 Literature cited

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Table 1: Ecosystem Service Typology
(Adapted from Cousins et al., 2020; FEMA, 2022)

Ecosystem service	Definition
Provisioning services	
• Energy and raw materials	Providing fuel, fiber, fertilizer, minerals, and energy.
• Food Provisioning	Producing crops, fish, game, and fruits.
• Medicinal resources	Providing traditional medicines, pharmaceuticals, and assay organisms.
• Ornamental resources	Providing resources for clothing, jewelry, handicraft, worship, and decoration.
• Water storage	Providing long term reserves of usable water via storage in lakes, ponds, aquifers, and soil moisture.
Regulating services	
• Air quality	Providing clean, breathable air.
• Biological control	Providing pest, weed, and disease control.
• Climate regulation	Supporting a stable climate at global and local levels through carbon sequestration and other processes.

• Hazard risk reduction	Preventing and mitigating natural hazards such as floods, hurricanes, fires, and droughts.
• Pollination	Pollinating wild and domestic plant species via wind, insects, birds, or other animals.
• Soil formation	Accumulating soils (e.g., via plant matter decomposition or sediment deposition in riparian/coastal systems) for agricultural and ecosystem integrity.
• Soil quality	Maintaining soil fertility and capacity to process waste inputs (bioremediation).
• Erosion control	Retaining arable land, slope stability, and coastal integrity
• Water filtration	Removing water pollutants via soil filtration and transformation by vegetation and microbial communities.
• Water supply	Regulating the rate of water flow through an environment and ensuring adequate water availability for all water users.
Supporting services	
• Habitat	Providing shelter, promoting growth of species, and maintaining biological diversity.
• Pollination	Pollinating wild and domestic plant species via wind, insects, birds, or other animals.
• Nutrient cycling	Transfer of nutrients from one place to another; transformation of critical nutrients and unusable to usable forms.
Information services	
• Aesthetic value	Enjoying and appreciating the scenery, sounds, and smells of nature.
• Existence value	Well-being gained by the knowledge that an environmental resource exists, even without on-site use of that resource.
• Cultural value	Providing opportunities for communities to use lands with spiritual, religious and historic importance.
• Research and education	Using natural systems for education and scientific research.
• Recreation/tourism	Experiencing the natural world and enjoying outdoor activities.

Table 2: Ecosystem Service Valuation Methods

(Adapted from FEMA, 2022; Batker et al. 2008)

Method	Description	Example
Direct Market Valuation		
Market Price	Valuations are directly obtained from the prices paid for the good or service in markets.	The price of wheat sold on open markets.
Replacement Cost	Cost of replacing the ecosystem service with engineered systems.	The cost of replacing a watershed's natural filtration capacity with a water filtration plant.
Avoided Cost	Costs that are incurred when the ecosystem service is lost.	Wetlands absorb and retain water, reducing flooding to downstream infrastructure. Flooding increases when the wetlands are lost or degraded.

Production Approaches	Value created from an ecosystem service through increases to dependent economic outputs.	Better grazing land health may increase stocking rates for livestock.
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Revealed Preference Approaches

Travel Cost	Costs incurred to consume or enjoy ecosystem services reflect a minimum implicit value of the service.	Tourists who travel to visit a locale must value that resource at least as much as the cost of traveling there.
Hedonic Pricing	Value implied by the additional price consumers are willing to pay for the service in related markets.	Property values near lakes and parks tend to exceed similar properties without such nearby amenities.
Contingent behavior	Value inferred from activity and time use decisions under different scenarios.	Time spent learning about and watching birds if a wildlife refuge were established nearby.

Stated Preference Approaches

Contingent valuation	Value elicited by posing hypothetical, valuation scenarios.	What people are willing to pay to protect an endangered species.
Choice experiments	Value inferred by choices for bundled goods with different level of provision and costs.	Three alternative scenarios for size and management of a protected area.

Table 3: Ecosystem Service Values – State Trust Lands

(Cousins et al., 2020)

		2018\$	2026\$		(2026\$ mil)
Land cover (attribute)	Ecosystem services valued	\$/acre/year	\$/acre/year	Acres	Annual value
Agriculture (annuals)	Cultural value, biological control, pollination and seed dispersal	\$3.00	\$3.99	187,915	\$0.75
Agriculture (perennials)	Pollination and seed dispersal	\$2,821.00	\$3,751.32	17,856	\$66.98
Forests (riparian, all)	Habitat	\$0.08	\$0.11	185,231	\$0.02
Forests (upland, all)	Soil retention, water quality	\$138.00	\$183.51	1,882,635	\$345.48
Forests (riparian, evergreen)	Soil retention	\$3.09	\$4.11	136,214	\$0.56
Forests (riparian, non-evergreen)	Soil retention	\$1.00	\$1.33	49,017	\$0.07
Forests (rural)	Water capture, conveyance and supply	\$428.00	\$569.15	2,085,219	\$1,186.80
Forests (urban)	Air quality, habitat, water capture, conveyance and supply	\$1,721.00	\$2,288.56	22,863	\$52.32
Forests (highways)	Air quality	\$523.00	\$695.48	850	\$0.59
Grasses (agricultural border)	Biological control, disaster risk reduction, soil retention	\$5,229.00	\$6,953.44	5,161	\$35.89
Rangeland (all)	Food (forage)	\$61.00	\$81.12	517,415	\$41.97
Wetlands (all)	Cultural value, energy and raw materials, water storage	\$124.00	\$164.89	21,572	\$3.56
Wetlands (agricultural border)	Disaster risk reduction, habitat, water capture, conveyance, and supply, water quality	\$29,206.00	\$38,837.67	288	\$11.19
Wetlands (coastal)	Habitat	\$423.00	\$562.50	351	\$0.20
Wetlands (non-agricultural border)	Disaster risk reduction, water capture, conveyance, and supply, water quality	\$3,423.00	\$4,551.85	21,284	\$96.88
Wetlands (non-agricultural border, non-coastal)	Habitat	\$188.00	\$250.00	20,933	\$5.23
Wetlands (urban)	Aesthetic information	\$10,595.00	\$14,089.06	938	\$13.22
			Totals:	5,155,742	\$1,861.70

Table 4: Ecosystem Service Values – Puget Sound

(Batker et al., 2008)

Ecosystem classification	Services valued	Acres	(2006\$)	Low (2026\$)	(2026\$ mil)	(2006\$)	High (2026\$)	(2026\$ mil)
			\$/acre/year	\$/acre/year	Annual value	\$/acre/year	\$/acre/year	Annual value
Pole forest	Gas and climate regulation, water flow regulation	729,333	\$32.20	\$53.33	\$38.90	\$445.95	\$738.64	\$538.72
Mid forest	Gas and climate regulation, water flow regulation, pollination, aesthetic/recreational	1,374,387	\$78.26	\$129.63	\$178.16	\$1,093.00	\$1,810.38	\$2,488.16
Late/old forest	Gas and climate regulation, water flow regulation, pollination, aesthetic/recreational, habitat refugia	1,381,127	\$395.77	\$655.53	\$905.37	\$2,272.00	\$3,763.20	\$5,197.46
Riparian forest pole	Gas and climate regulation, water flow regulation, aesthetic/recreational	215,617	\$1,075.20	\$1,780.90	\$383.99	\$11,070.00	\$18,335.67	\$3,953.48
Riparian forest mid-late	Gas and climate regulation, disturbance regulation, water flow regulation, water supply, habitat refugium, pollination, aesthetic/recreational	814,628	\$3,479.00	\$5,762.40	\$4,694.22	\$25,226.00	\$41,782.81	\$34,037.45
Freshwater wetland	Gas and climate regulation, water flow regulation, water supply, habitat refugium, aesthetic/recreational	215,907	\$6,676.61	\$11,058.73	\$2,387.66	\$59,914.27	\$99,238.34	\$21,426.25
River/lakes	Water supply, habitat refugium, aesthetic/recreational	121,905	\$77.71	\$128.71	\$15.69	\$22,013.28	\$36,461.45	\$4,444.83
Grassland/herbaceous	Gas and climate regulation, water flow regulation, water quality, pollination, soil erosion control, soil formation, biological control	320,443	\$96.35	\$159.59	\$51.14	\$96.35	\$159.59	\$51.14
Agriculture	Pollination, aesthetic/recreational	73,266	\$29.90	\$49.52	\$3.63	\$39.60	\$65.59	\$4.81
Pasture	Soil formation, aesthetic/recreational	307,242	\$6.25	\$10.35	\$3.18	\$6.25	\$10.35	\$3.18
Urban green space	Gas and climate regulation, water flow regulation, aesthetic/recreational	421,574	\$1,293.84	\$2,143.04	\$903.45	\$4,743.10	\$7,856.18	\$3,311.96
Beach	Disturbance regulation, aesthetic/recreational	48,341	\$22,353.32	\$37,024.68	\$1,789.81	\$81,528.01	\$135,038.02	\$6,527.87
Salt marsh	Disturbance regulation, water flow regulation, habitat refugium, aesthetic/recreational	83,144	\$358.74	\$594.20	\$49.40	\$114,739.48	\$190,047.48	\$15,801.31
Eel grass beds	Nutrient cycling	49,422	\$5,507.00	\$9,121.46	\$450.80	\$15,421.00	\$25,542.40	\$1,262.36
Estuary waters	Water supply, habitat refugium, aesthetic/recreational	552,712	\$18.62	\$30.84	\$17.05	\$1,868.51	\$3,094.89	\$1,710.58
Marine waters	Water supply	1,127,891	\$259.34	\$429.55	\$484.49	\$772.68	\$1,279.82	\$1,443.50
Total:		7,836,939		Total:	\$12,356.93		Total:	\$102,203.05

Table 5: Ecosystem Service Values – 2026\$/acre/year
(FEMA, 2022)

	Urban green open space	Rural green open space	Riparian	Forest	Coastal wetland	Inland wetland	Coral reefs	Shellfish reefs	Beaches and Dunes
Aesthetic value	\$8,638	\$9,248	\$945	\$1,820	\$2,031	\$1,606	\$403	\$0	\$275,839
Air quality	\$248	\$0	\$313	\$876	\$0	\$0	\$0	\$0	\$0
Biological control	\$0	\$0	\$245	\$0	\$0	\$0	\$0	\$0	\$0
Climate regulation	\$67	\$95	\$118	\$245	\$154	\$69	\$0	\$0	\$0
Erosion control	\$96	\$96	\$17,034	\$2,060	\$0	\$0	\$0	\$0	\$0
Existence value	\$0	\$0	\$0	\$9,280	\$0	\$0	\$0	\$0	\$0
Flood and storm hazard re	\$389	\$0	\$7,458	\$453	\$1,275	\$1,558	\$4,028	\$0	\$0
Food provisioning	\$0	\$0	\$907	\$0	\$0	\$0	\$22	\$2,348	\$0
Habitat	\$7,258	\$2,490	\$3,139	\$0	\$2,982	\$1,745	\$2,738	\$0	\$0
Pollination	\$431	\$431	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Recreation/tourism	\$2,023	\$741	\$7,659	\$116	\$2,001	\$2,349	\$1,554	\$312	\$94,652
Research and education	\$0	\$0	\$0	\$0	\$0	\$0	\$28	\$0	\$0
Water filtration	\$0	\$0	\$7,688	\$536	\$1,920	\$1,952	\$0	\$739	\$0
Water supply	\$0	\$0	\$335	\$127	\$670	\$792	\$0	\$0	\$0
<i>Total:</i>	\$19,151	\$13,102	\$45,842	\$15,515	\$11,034	\$10,070	\$8,774	\$3,399	\$370,492

**Table 6: Variation in Ecosystem Classification
Relevant to Island County Decision Making**

NatureServe (2009) – North Pacific and Puget associations	
Forests	
•	North Pacific dry Douglas fir (madrone) forest and woodland
•	North Pacific lowland mixed hardwood conifer forest
•	North Pacific maritime dry mesic Douglas fir western hemlock forest
•	North Pacific maritime wet mesic Douglas fir western hemlock forest
•	North Pacific oak woodland
•	North Pacific dry mesic silver fir western hemlock Douglas fir forest
•	North Pacific hypermaritime seasonal Sitka spruce forest
•	North Pacific hypermaritime western red cedar hemlock forest
•	North Pacific lowland riparian forest and shrubland
Grasslands	
•	Willamette valley upland prairie and savanna (in Puget Trough)
Wetlands	
•	North Pacific bog and fen
•	Willamette valley wet prairie (in Puget Trough)
•	North Pacific intertidal freshwater wetlands
•	North Pacific hardpan vernal pool
•	Temperate Pacific freshwater mudflat
•	Temperate Pacific intertidal flat
•	North Pacific hardwood-conifer swamp
Coastal	
•	North Pacific maritime coastal sand dune and strand
•	North Pacific coastal intertidal wetland
•	North Pacific maritime eelgrass bed
•	North Pacific coastal cliff and bluff
•	North Pacific herbaceous bald and bluff
•	North Pacific active inland dune
Cousins et al. (2020) – DNR Trust Lands classifications	
Forests	
•	Riparian
•	Upland
•	Riparian - evergreen
•	Riparian – non-evergreen
•	Rural
•	Urban
•	Highway corridors
Grasslands	
•	Agricultural borders
•	Rangelands
Wetlands	
•	Wetlands - all
•	Agricultural borders
•	Coastal
•	Non-agricultural borders, non-coastal
•	Urban

Table 6, continued

Batker et al. (2008) – Puget Sound	
Forests	
• Pole forests	
• Mid-aged forests	
• Late successional/old growth forest	
• Riparian pole forest	
• Riparian mid-late age forest	
Aquatic ecosystems	
• Freshwater wetlands	
• Rivers and lakes	
• Salt marshes	
• Eel grass beds	
• Estuary waters	
• Marine waters	
Intensive use areas	
• Agriculture	
• Urban green space	
Grasslands	
• Grassland and herbaceous cover	
• Pasture	
FEMA (2022) - US	
Open space	
• Urban green open space	
• Rural green open space	
Inland aquatic	
• Riparian	
• Inland wetland	
Coastal	
• Coastal wetlands	
• Coral reefs	
• Shellfish reefs	
• Beaches and dunes	
Forests	
Island County (2025) – Comprehensive Plan	
Critical areas	
• Wetlands	
• Critical aquifer recharge areas	
• Fish and wildlife conservation areas	
• Frequently flooded areas	
• Geologically hazardous areas	
Natural lands	
• Agriculture	
• Forestry	
• Wetland protection	
• Open space corridors	