Quantifying the Economic Benefits of Springs in the Lower Suwannee and Santa Fe River Basins of North-Central Florida

Alachua County,
Florida

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Quantifying the Economic Benefits of Springs in the Lower Suwannee and Santa Fe River Basins of North-Central Florida

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Manatee Springs, FWC

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Five complementary analyses — visitation, economic contributions, recreational value, ecosystem services, and public perceptions — are integrated to quantify the full economic and social value of public springs in North-Central Florida.

1 VISITATION | 15 state and county spring sites, 2013–2024

1.38M
avg visitor-days/yr
2013-2024 average

1.15M
visitor-days (2024)
Post-pandemic recovery

81%
non-local visitors
Regional & statewide draw

~600K
Gilchrist Blue Springs
Highest single-site visits/yr

Note: Private springs (Devils Den, Ginnie Springs, Blue Grotto, Hornsby) excluded — all estimates are conservative lower bounds.

2 ECONOMIC CONTRIBUTIONS | Visitor expenditures modeled through IMPLAN

427
jobs supported
Full-, part-time & proprietor

$11.1M
labor income/yr
Direct + indirect + induced

$22.1M
regional GDP/yr
Value added to local economy

$7.9M
tax revenues/yr
Fed $3.2M | State $2.0M | Local $2.6M

County	Jobs	Labor Inc.	GDP	Spring sites
Gilchrist	288	$6.4M	$13.2M	Hart Springs, Blue Springs SP
Suwannee	59	$2.0M	$3.8M	Wes Skiles Peacock Springs SP
Columbia	47	$1.7M	$3.2M	Rum Island Springs
Levy	30	$0.8M	$1.6M	Fanning Springs SP
Alachua + Lafayette	3	<$0.1M	$0.2M	Poe, Lafayette Blue, Troy SP
TOTAL	**427**	**$11.1M**	**$22.1M**	**All springs combined**

3 NON-MARKET RECREATIONAL VALUE | Travel cost method, non-local visitors (N=73)

$8.40
CS per trip (conservative)
Shaw-corrected; p<0.10

$10.97
CS per trip (standard)
Neg. binomial; p<0.05

$7.8M
annual value (low)
930K non-local visitor-days

$10.2M
annual value (high)
Standard CS x visitation

Consumer surplus is the benefit visitors receive above actual spending — invisible in expenditure data but real. It is directly tied to spring condition. Visitors stated they would take ~39 more trips/year if water quality improved and ~44 more if crowding were reduced.

4 ECOSYSTEM SERVICES | Benefit transfer + GIS land cover mapping (low estimates)

>$37.5M
per year
5-mile buffers, 14 springs

>$175M
per year
Spring Protection Areas (5 SPAs)

$18.7M
carbon sequestration
Largest single ecosystem service

$15.7M
water quality
Nutrient removal & filtering

Spring Protection Area	Water quality	Carbon	Flood	Total (low est.)
Troy-Peacock-Lafayette-Falmouth	$47.1M	$45.3M	$16.2M	>$123M
Ichetucknee	$17.3M	$12.1M	$5.0M	~$39.6M
Fanning-Manatee	$4.1M	$4.2M	$1.7M	~$10.6M
Devil's Ear	$2.9M	$3.5M	$0.2M	~$7.5M
Columbia-Hornsby-Treehouse	$0.8M	$0.7M	$0.2M	~$3.7M
ALL PROTECTION AREAS	**$72.3M**	**$65.8M**	**$23.3M**	**>$175M/yr**

Key insight: Wetland or forest loss within a SPA could mean millions in foregone nutrient removal, flood protection, and carbon storage annually.

5 PUBLIC PERCEPTIONS | Statewide survey + framing experiment (N = 1,806)

Message	Predicted support	vs. control	Significance
Ecological framing	**95.8%**	+5.8 pp	Significant (OR=2.56, p=0.001)
Gain frame (positive outcomes)	**92.3%**	+2.3 pp	Not significant (p=0.081)
Control (no message)	**90.0%**	—	Reference group
Loss frame (threats/harms)	**90.5%**	+0.5 pp	Not significant (p=0.732)
Economic framing	**88.0%**	-2.0 pp	Not significant (p=0.214)

Lead with ecology, not economics. Ecological framing is the only message that significantly increases support. Economic framing slightly reduces it. Gain frames (what we protect) outperform loss frames.

6 MANAGEMENT IMPLICATIONS

Lead with ecology, not economics. Ecological framing is the only message that significantly increases support. Economic framing slightly reduces it. Gain frames (what we protect) outperform loss frames.

Spring protection = economic investment	$42.1M output, $10.2M recreational value, and $7.9M in tax revenues are all tied to spring condition. Degradation reduces these; restoration increases them.
Landscape-scale conservation matters most	Most ecosystem service value is in Spring Protection Areas, not at vents. Land use in recharge zones and wetlands has large downstream consequences for spring quality.
Lead with ecology in public outreach	Ecological framing is the only message that significantly boosts public support. Economic framing slightly reduces it. Gain frames outperform loss frames.
Springs recreation supports local economies	Gilchrist County alone gains 288 jobs and $13.2M in GDP annually. Even smaller springs in Levy, Columbia, and Alachua counties generate measurable employment and tax revenues.
Improve visitation monitoring at county parks	Free-entry county parks lack reliable visitor counts. Basic monitoring investment would substantially improve the precision of future economic assessments.

1. INTRODUCTION

Florida's freshwater springs are among the state's most iconic and valuable natural resources, supporting unique ecological systems, recreational opportunities, and regional economies. Concentrated primarily in north and north-central Florida, these spring systems provide critical connections between groundwater, surface waters, and surrounding landscapes, sustaining river baseflows, aquatic habitat, and water quality across large portions of the Suwannee and Santa Fe River basins. Beyond their ecological significance, springs are central to Florida's natural heritage and quality of life, attracting millions of visitors annually and supporting nature-based recreation, tourism, and local livelihoods.

Over recent decades, however, Florida's springs have experienced increasing pressure from groundwater withdrawals, land use change, and nutrient loading. These stressors have contributed to declining spring flows, reduced water clarity, algal growth, and broader degradation of spring-dependent ecosystems. As a result, there is growing recognition that effective spring protection and restoration requires not only site-specific management, but also a landscape-scale understanding of how surrounding land uses, human activities, and public perceptions interact to influence spring condition and value.

Addressing these pressures effectively requires decision-relevant information that reflects the full suite of benefits springs provide. Previous economic studies of Florida springs have focused primarily on recreational visitation and tourism impacts, documenting visitor spending, employment effects, and economic contributions associated with spring-based recreation. While these studies provide important insights, they capture only a subset of the total benefits generated by spring systems. Springs and their surrounding landscapes also provide non-market ecosystem services, such as nutrient removal, carbon sequestration, flood attenuation, and aesthetic benefits, which are not reflected in market transactions but are essential to long-term environmental and economic sustainability. Equally important, understanding how the public perceives springs, values management actions, and responds to policy framing is increasingly central to designing conservation strategies that will be supported in practice.

The present report responds to these gaps by providing a comprehensive economic and social assessment of Florida's spring systems that integrates recreational use, economic contributions, ecosystem service valuation, and public preferences within a single analytical framework. Specifically, this report addresses five interrelated tasks. First, it documents springs visitation trends by compiling and verifying visitation data for both publicly and privately owned springs. Second, it estimates the monetary economic contributions of nature-based recreation at selected springs using on-site expenditure data and regional input–output modeling. Third, it quantifies the consumer surplus associated with spring-based recreation using a travel cost method, providing estimates of the non-market recreational value experienced by visitors.

Fourth, it evaluates the ecosystem services provided by spring-connected landscapes, including water quality improvement, carbon sequestration, flood attenuation, and water clarity, using benefit transfer and avoided cost approaches. Finally, it examines public perceptions and preferences for springs management and valuation through a statewide survey, including a policy framing experiment designed to inform communication and outreach strategies.

Together, these tasks provide an integrated framework for understanding the full range of economic, ecological, and social values associated with Florida’s springs. The results are intended to support spring managers, policymakers, and stakeholders by providing defensible, policy-relevant information that can inform conservation prioritization, land use planning, and long-term spring protection efforts. The remainder of this report is organized to reflect this framework: the present section situates the current work relative to a baseline 2014 assessment, and Sections 2 through 5 then present the visitation, economic contribution, recreational value, ecosystem services, and public perceptions analyses in turn. A final section synthesizes these findings into implications for county-level environmental management.

1.1 PAST STUDY IN 2014

A prior economic assessment of Florida’s spring systems in the Suwannee and Santa Fe River basins in 2014 established an important baseline for understanding visitation patterns, recreational value, and economic contributions associated with spring-based recreation. That study relied on a combination of park-reported visitation data, on-site visitor surveys, and input–output modeling to estimate regional economic impacts and non-market recreational benefits. In addition, the earlier work incorporated both publicly and privately owned springs, allowing for a more comprehensive representation of total recreational use across the study area.

One notable distinction between the past study and the current analysis is the availability of visitation data from privately owned springs. In the previous study, private spring operators were responsive to data requests, enabling inclusion of key high-use sites such as privately managed springs in visitation and economic impact estimates. As a result, total visitation and associated economic contributions reflected both public and private recreation activity, providing a more complete estimate of system-wide use.

In contrast, the current study encountered limited responsiveness from private spring operators despite multiple outreach attempts. Consequently, visitation estimates and subsequent economic analyses presented in this report are limited to publicly managed state and county springs. The exclusion of privately owned springs likely results in a conservative estimate of total visitation, recreational value, and economic contributions within the region.

Given that several private springs are known to attract substantial visitor volumes, their omission represents an important limitation when comparing aggregate results across studies.

Beyond differences in data availability, the present report expands upon the prior study by adopting a more integrated and comprehensive framework. While the earlier work focused primarily on recreational visitation and economic impacts, this report incorporates additional dimensions, including ecosystem service valuation, consumer surplus estimation using advanced travel cost modeling, and a statewide assessment of public perceptions and policy preferences. These additions provide a broader understanding of the total economic, ecological, and social value of Florida's springs, while also improving the policy relevance of the findings.

1.2 IMPLICATIONS

The integrated framework adopted in this report has several implications for how county-level environmental managers and partner agencies can interpret and apply the findings that follow. Because the five component analyses—visitation, economic contributions, recreational value, ecosystem services, and public perceptions—are complementary rather than redundant, each captures a different dimension of value that is likely to be under-counted when considered in isolation. Management decisions informed by expenditure-based impact figures alone will systematically undervalue springs, because they omit the non-market welfare that visitors receive, the ecosystem services provided by spring-connected landscapes, and the latent public support that can be mobilized through effective communication.

A second implication concerns the conservative nature of the estimates presented throughout this report. The exclusion of privately owned springs such as Devil's Den, Ginnie Springs, Blue Grotto, and Hornsby Springs—each known to attract substantial visitor volumes—means that all visitation, expenditure, and recreational value figures should be interpreted as lower bounds on the true regional totals. Where county policy or budget decisions depend on these numbers, managers should recognize that **the real contribution of spring-based recreation to the Lower Suwannee and Santa Fe River basins is likely meaningfully larger than reported here.** This strengthens, rather than weakens, the case for sustained investment in spring protection.

Finally, the landscape-scale orientation of the framework has direct implications for how county environmental management agencies define their scope of action. Spring condition is determined not only by activities at the spring vent, but also by groundwater withdrawals, land use, and nutrient loading across the broader recharge area. An assessment that considers only on-site recreational value would miss the substantial off-site and non-market benefits tied to surrounding land cover. The sections that follow therefore move progressively from on-site visitation and expenditures to off-site ecosystem services and region-wide public perceptions, mirroring the spatial and conceptual scales at which spring protection must be pursued.

2. VISITATION OF SPRINGS

In this section, we estimate how many visitors have recreated at the springs in our study from 2013-2024. These visitation estimates are used in estimating the monetary contribution of recreational opportunities in the springs in the subsequent section.

2.1 DATA SOURCES AND ANALYTICAL APPROACH

To estimate the number of visitors for the publicly owned springs, we contacted park managers who collected this data from visitor use fees, camping permits, vehicle counts, etc. State parks had reliable estimates, mostly through entrance fee tracking. However, we encountered multiple county parks that did not have reliable estimates, as they did not have staff dedicated to monitoring entrance fees, or they did not have entrance fees to enter the spring. Little River Spring County Park provided data from 2019-2024, which was used to estimate the rest of the county-managed springs. A detailed explanation of how these estimates were calculated are presented below under the, ‘Missing Data’ section.

It should be noted that our estimates do not include four privately-owned springs in the area: Devil’s Den, Ginnie Springs, Blue Grotto, and Hornsby Springs. These parks were contacted, but researchers did not receive a response.

2.1.1 MISSING DATA

There were several cases of missing data across spring sites. Due to the nature of the missing data, we used either an average or ratio-based imputation method (Table X).

We estimated an average for Fanning Springs, Manatee Springs, and Little River County Park. For Fanning Springs and Manatee Springs State Park, there were three and four years, respectively, with missing data. To mitigate this, we average the previous and following year visitation to fill in the missing year (Klizentyte & Stein, 2019; 2020; 2021).

To estimate the missing visitor data for several county-managed springs, we used a ratio-based imputation method anchored on the year 2013 — the only year with available visitation data for all four relevant springs: Hart Springs, Poe Springs, Rum Island, and Little River Spring County Park. In this base year, we calculated the ratio of visitors to each spring relative to the number of visitors to Little River Spring, which served as our reference site because it had a reliable visitation estimate. Specifically, we divided each spring’s 2013 visitor count by Little River’s 2013 count (3,333), yielding ratios of approximately 7.47 for Hart Springs, 1.23 for Poe Springs, and 2.84 for Rum Island.

For years in which Little River visitation data was available (2019–2024), we applied these fixed ratios to the actual visitor numbers at Little River in each respective year. This allowed us to generate estimated visitor counts for the other three springs by assuming a stable proportion of use between each spring and Little River over time.

For the earlier period (2014–2018), where Little River visitor data was unavailable, we used the average number of visitors to Little River from the known years (2019–2024) as a proxy baseline. This average was calculated as 51,050 visitors per year. We then multiplied this average by each spring's 2013-based ratio to estimate the missing values in those years. This method assumes that the relative popularity of these county parks remained stable over time and allows us to fill in gaps in the dataset using observed visitation trends.

By maintaining consistent relative ratios and grounding all estimates in real data from both a reference year and a reference site (Little River), this approach ensures that our imputed values reflect the broader visitation patterns in a transparent and replicable way.

Table 1. Missing Data Methods for Springs in Our Sample.

Spring Name	Management Type	Data Availability	Years Missing	Imputation Method	Notes
Fanning Springs State Park	State	Partial	3 years	Average	Based on Stein et al. (2022) approach
Manatee Springs State Park	State	Partial	4 years	Linear interpolation (average of adjacent years)	Same method as above
Blue Springs State Park	State	Complete	None	Not applicable	—
Ichetucknee Springs State Park	State	Complete	None	Not applicable	—
Lafayette Blue Springs State Park	State	Complete	None	Not applicable	—
Troy Springs State Park	State	Complete	None	Not applicable	Includes anomalous spike in 2017
Wes Skiles Peacock Springs State Park	State	Complete	None	Not applicable	—
Hart Springs County Park	County	Limited	Multiple (2014–2018)	Ratio-based imputation (Little River reference)	Anchored to 2013 ratios
Poe Springs County Park	County	Limited	Multiple (2014–2018)	Ratio-based imputation (Little River reference)	Anchored to 2013 ratios
Rum Island County Park	County	Limited	Multiple (2014–2018)	Ratio-based imputation (Little River reference)	Anchored to 2013 ratios
Little River Spring County Park	County	Partial	2014–2018	Average (2019–2024 average)	Used as reference site

2.2 VISITATION LEVELS

Across both state- and county-managed springs, visitation patterns reflect a combination of long-term growth and decline cycles and widespread disruptions during the COVID-19 period (Table 1). While several high-use state parks demonstrated strong recovery following 2020, many smaller and county-managed springs exhibited weaker recovery by 2024. These patterns highlight substantial heterogeneity in visitor use across spring systems and underscore the importance of site-specific management considerations when evaluating recreational demand and associated impacts.

2.2.1 STATE PARKS

Among state parks, Gilchrist Blue Springs exhibited the highest and most stable visitation levels throughout the study period, with annual visitation generally ranging between approximately 540,000 and 660,000 visitors prior to 2020. Following a decline in 2020, visitation rebounded in subsequent years, reaching over 598,000 visitors in 2024 (Figure 1). This pattern suggests sustained high demand with temporary disruption during the COVID-19 period.

Ichetucknee Springs experienced pronounced growth between 2013 and 2016, with visitation increasing from approximately 150,000 to nearly 480,000 visitors. After peaking in the mid-2010s, visitation declined steadily through 2020 and remained at lower but relatively stable levels between 2021 and 2024, fluctuating around 220,000–260,000 annual visitors.

Manatee Springs followed a similar pattern of mid-decade growth followed by gradual decline. Visitation increased from approximately 155,000 visitors in 2013 to over 300,000 in 2016, before declining and stabilizing at approximately 160,000–170,000 visitors annually in recent years.

In contrast, Fanning Springs exhibited greater volatility, with visitation peaking in 2015–2016 at over 215,000 visitors before declining in subsequent years. Visitation dropped markedly in 2020 and remained substantially lower through 2024, falling below 70,000 visitors in the most recent year.

Smaller state-managed sites, including Lafayette Blue Springs, Troy Spring, and Wes Skiles Peacock Springs, consistently recorded lower visitation levels. Lafayette Blue Springs experienced a gradual decline over time, with visitation falling from approximately 24,000 visitors in 2013 to fewer than 3,000 in 2024. Troy Spring showed highly variable visitation, including a notable spike in 2017, followed by generally low and declining visitation in later years. Wes Skiles Peacock Springs maintained relatively stable but modest visitation levels throughout the period, typically ranging between 12,000 and 23,000 visitors annually.

2.2.2 COUNTY PARKS

County-managed springs exhibited lower overall visitation relative to state-managed sites but displayed notable increases in certain years. Hart Springs showed relatively stable visitation between 2013 and 2019, followed by a sharp increase in 2022 and 2023, before declining again in 2024. A similar pattern was observed for Little River Spring, with substantial increases beginning in 2019 and peaking in 2022–2023.

Poe Springs and Rum Island Spring followed comparable trajectories, with gradual increases through the mid-2010s, declines in 2020–2021, and temporary rebounds in 2022 and 2023. By 2024, visitation at these county-managed sites declined again, returning to levels closer to or below pre-pandemic values. It is important to note that many of these estimates for county parks were calculated using ratio proportions from Little River County Park, which was one of the only county parks with valid visitation data.

Table 2. Yearly visitation patterns of state and county springs parks (those in *italics* were estimated).

Park	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
State												
Gilchrist Blue Springs	654,889	580,500	664,584	576,277	539,310	537,515	561,381	492,004	553,305	646,710	569,784	598,329
Manatee Springs	154,701	*223,093*	291,485	308,175	*282,403*	256,631	174,642	*166,711*	158,780	*161,947*	165,115	168,249
Ichetucknee Springs	149,702	231,608	477,435	475,619	357,104	286,557	298,693	221,161	257,201	217,435	238,353	230,601
Fanning Springs	141,200	*180,081*	218,963	216,114	*198,268*	180,423	179,322	*114,000*	48,679	93,837	81,802	69,767
Lafayette Blue Springs	23,817	20,743	27,552	30,107	26,472	14,015	22,039	10,666	9,611	12,158	8,145	2,473
Wes Skiles Peacock Springs	23,137	20,619	12,006	12,540	12,024	12,581	12,077	19,815	16,192	18,759	14,009	12,430
Troy Spring	3,902	4,473	8,039	8,064	100,647	6,606	12,962	7,518	6,504	9,573	7,505	1,772
County												
Hart Springs	*24,889*	*51,658*	*51,658*	*51,658*	*51,658*	*51,658*	*57,900*	*45,500*	*33,300*	*75,200*	*68,800*	*25,600*
Rum Island Spring	*9,451*	*19,630*	*19,630*	*19,630*	*19,630*	*19,630*	*22,038*	*17,330*	*12,692*	*28,667*	*26,236*	*9,782*
Poe Springs	*4,098*	*8,511*	*8,511*	*8,511*	*8,511*	*8,511*	*9,542*	*7,502*	*5,498*	*12,412*	*11,361*	*4,230*
Little River Spring	*3,333*	*6,921*	*6,921*	*6,921*	*6,921*	*6,921*	57,900	45,500	33,300	75,200	68,800	25,600
TOTAL	**1,193,119**	**1,347,837**	**1,786,784**	**1,713,616**	**1,602,948**	**1,381,048**	**1,408,496**	**1,147,707**	**1,135,062**	**1,351,898**	**1,259,910**	**1,148,833**

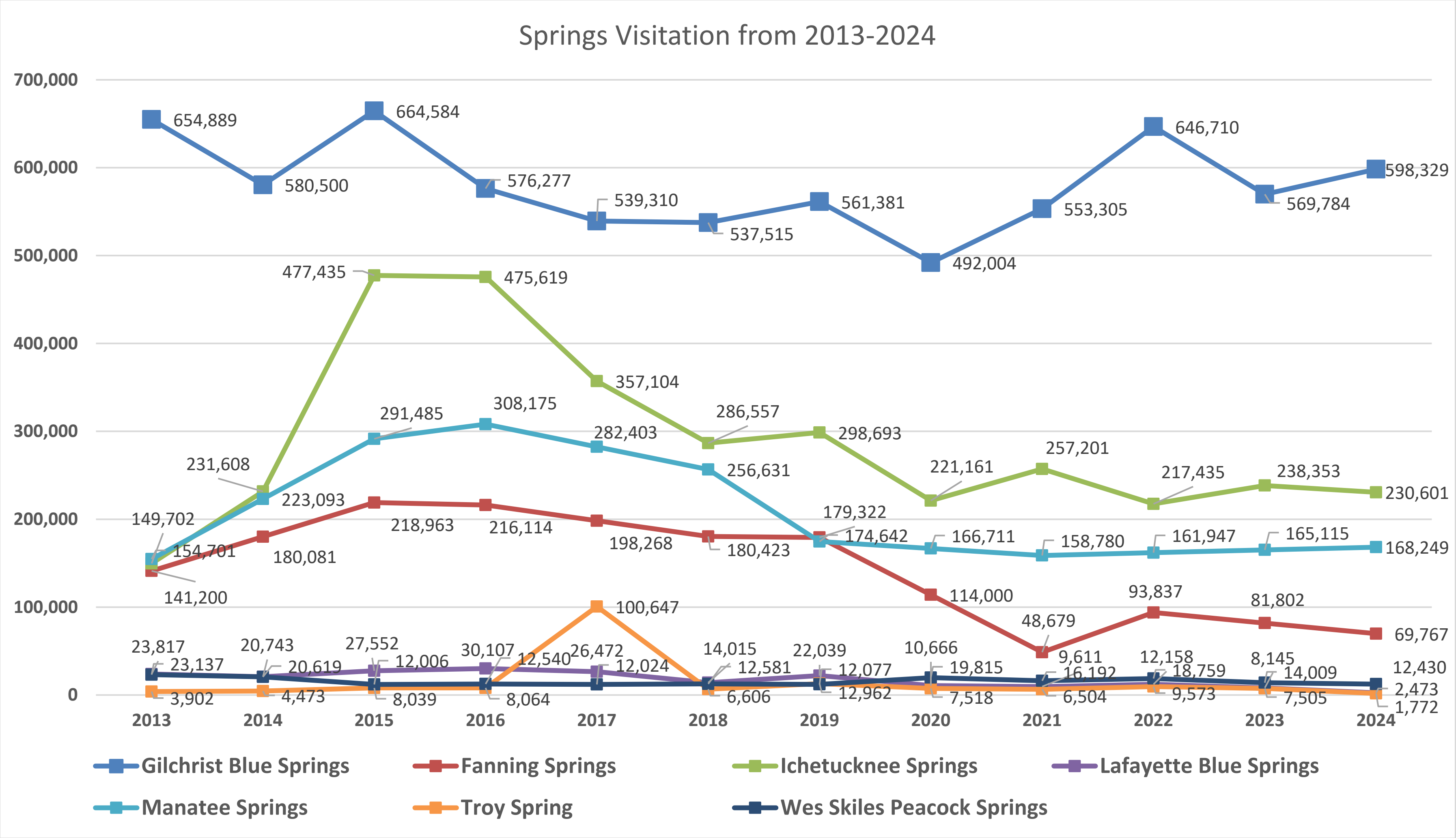

Figure 1. Springs visitation from 2013-2024

2.3 IMPLICATIONS

The visitation patterns documented in this section carry several implications for county-level management and planning. Across the twelve-year study period, average visitation to the fifteen publicly managed spring sites exceeded 1.38 million visitor-days per year, with more than 1.14 million visitor-days recorded even in 2024—a post-pandemic year in which many sites had not fully recovered. This sustained level of use indicates that public spring sites in the Lower Suwannee and Santa Fe River basins remain a regional destination of statewide significance, and that demand pressure on these sites is unlikely to diminish in the near term.

Substantial heterogeneity across sites has direct management implications. Gilchrist Blue Springs consistently accounts for nearly half of total system visitation, while smaller state-managed sites such as Lafayette Blue Springs and Troy Spring and most county-managed sites record visitation an order of magnitude lower. High-use sites face concentrated crowding and infrastructure pressures that may justify targeted investment in capacity management, facilities, and water quality protection, whereas lower-use sites may benefit more from interpretive programming, access improvements, and the kinds of ecological restoration that support long-term condition. Uniform management prescriptions across sites of such different scale are unlikely to be efficient.

Post-2020 visitation patterns also warrant attention. While several high-use state parks recovered strongly after the COVID-19 disruption, sites including Fanning Springs, Lafayette Blue Springs, and Troy Spring remained substantially below pre-pandemic levels through 2024. Declines of this magnitude can reflect a combination of environmental factors (water clarity, flow conditions, algal conditions) and management factors (access, amenities, operating hours), and they suggest that some sites may warrant targeted diagnostic assessment rather than being interpreted as experiencing normal year-to-year variation. For a county environmental management agency, persistent under-recovery at a specific site is a signal that the on-site experience or the surrounding resource base may be changing in ways that merit closer monitoring.

A final implication concerns the quality of the underlying data. Visitation at county-managed springs had to be estimated for most years in the study period using ratio-based imputation from Little River Spring, because free-entry county parks lack the fee-based tracking systems that state parks rely on. While the imputation approach is transparent and defensible, it introduces uncertainty that ultimately propagates through the economic contribution estimates in Section 3. Modest investment in consistent visitor counting at county-managed sites—through vehicle counters, seasonal staff, or periodic manual counts—would substantially improve the precision of future assessments and reduce the dependence of regional estimates on a single reference site.

3. MONETARY ECONOMIC CONTRIBUTIONS OF NATURE-BASED RECREATION AT THE SPRINGS

The springs provide direct monetary contributions through expenditures and entry fees, but their value to visitors far exceeds these direct payments. With the help of on-site visitor surveys, we asked respondents how much they typically spend on expenditures such as gas, groceries, and entry fees. Using IMPLAN software, we were able to estimate the economic contribution and tax impacts springs provide their counties. Due to time and survey constraints, this economic impact does not include any economic contributions related to scuba diving, which would likely increase contributions across this analysis.

3.1 DATA SOURCES AND ANALYTICAL APPROACH

3.1.1 ECONOMIC IMPACT AND IMPLAN

This study utilizes IMPLAN to estimate the economic impacts of springs visitation. IMPLAN (which stands for IMpacts for PLANning) was created in the 1970s by the United States Forest Service to estimate the economic outcomes of public land management policies. Today, IMPLAN remains a leading tool in estimating the economic impacts of changes in a study area economy. IMPLAN utilizes an input-output model which pairs an economic change being analyzed (here, expenditures resulting from spring visitation) with multipliers which estimate how the behavior being studied supports expenditures in other industries. For example, purchasing a meal from a restaurant after visiting a spring leads that restaurant to buy more supplies and pay utilities and employees. Depending on the scope of expenditures, this could support existing jobs and businesses or even create demand for new jobs and businesses in an industry, hence the authors use the phrase “support and/or generate” to frame economic impacts throughout the report.

IMPLAN examines economic impact effects across four measures: employment, labor income, value added, and output. These four ideas categorize how the economic activity being modeled leads to changes overall in the study area economy. *Employment* is a measure of the sum jobs supported and/or generated as a result of activity being studied. Note this figure includes full-time, part-time, and proprietor employment. *Labor income* estimates the amount of employee compensation supported and/or generated by the activity studied. This figure includes full-time, part-time, proprietor, and self-employed individuals. *Value added* is the Gross Domestic Product (GDP) contributed by the activity being studied and represents new spending and growth in the economy. Finally, *output* (which is a measure of total sales) includes both labor income and value added plus the intermediate inputs needed to conduct businesses.

These four measures are further delineated by three levels of activities occurring as expenditures move through the economy. These three levels are direct, indirect, and induced. Direct expenditures represent the change in the economy being studied. For our purposes, the direct effects will be the expenditures generated/supported by springs visitors, and these are discussed later in the methodology. Next, indirect effects examine business to business spending which occurs following the direct effect. Recall our earlier example of buying a meal at a restaurant. When a spring visitor buys a meal as a result of their visit (direct effect), the restaurant then creates additional expenditures as it buys new foodstuffs, restocks supplies like straws and napkins, and pay recurring expenditures like leases and utilities. These indirect expenditures also include payments to employees, which lead to induced effects. Induced effects examine household spending as income generated in the model is returned to the economy. For example, a chef from our restaurant example will use their labor income to support their everyday lives: buying groceries, paying mortgages, putting gasoline in their vehicle, and perhaps even going on their own visit to the springs.

3.1.2 EXPENDITURE PATTERNS

To model the economic impacts of springs visitation, the authors paired the visitation patterns established earlier in this report with survey-data expenditure patterns. The study survey included questions establishing common expenditure patterns for visitors to the springs examined. These included food purchases, travel purchases, retail purchases, lodging purchases, and park entrance fees (where applicable). Expenditure patterns included all visitors (local residents who reside in the nearby area as well as out of region tourism), which is appropriate for a study examining unique resources (here, springs) in a region. These expenditure patterns are then paired with visitation to each spring to estimate the total expenditures occurring. These expenditures are then built in IMPLAN.

Economic impact studies also utilize study areas to define where economic expenditures are initially occurring. Study areas include both the location of the activity being studied (here, springs visitation) and the nearby areas where expenditures are likely to occur as a result of the activity being studied (visitors spending funds at local restaurants, buying gas, and getting lodging for example). For this study, the authors utilized the counties in which each spring was located. In IMPLAN, a study area was created for each county. Next the expenditure patterns for each spring are then connected to its county. This allows for a nuanced model which accounts for differences in each county.

3.2 RESULTS

Table 2 summarizes the economic impacts of visitation to all public springs examined in this report across all study areas. Results indicate that visitor expenditures support over 400 jobs across the study areas alongside $11 million in labor income. Spring visitation supports $22 million in GDP (value added) and $42 million in total sales.

Table 3. Economic impact analysis for all springs in study.

Impact	Employment	Labor Income	Value Added	Output
Direct	368.84	$8,900,970.06	$17,846,562.55	$32,598,633.69
Indirect	43.99	$1,616,355.97	$2,672,235.53	$6,883,419.86
Induced	14.24	$535,355.08	$1,543,156.17	$2,592,804.20
Totals	427.08	$11,052,681.11	$22,061,954.25	$42,074,857.75

Table 3 describes the estimated tax benefits of springs visitation across all study areas. Here, county taxes (which include local and city taxes as well as special districts such as schools) generate around $2.6 million annually, while visitation also supports an estimated $2 million in state and $3.2 million in federal tax dollars. These are all largely the direct result of visitor expenditures, with supplemental activity occurring as their expenditures lead to activity throughout the economy.

Table 4. Tax results for all springs in study (rounded).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$193,804	$688,984	$1,520,413	$1,775,300	$2,599,919	$6,778,422
Indirect	$13,595	$44,837	$99,806	$132,460	$434,119	$724,818
Induced	$9,361	$26,609	$60,147	$96,747	$174,314	$367,180
Totals	$216,761	$760,432	$1,680,366	$2,004,508	$3,208,352	$7,870,421

3.2.1 COUNTY-SPECIFIC ECONOMIC IMPACTS

It is important to note that economic impacts are estimated within county-specific study areas based on where expenditures are assumed to occur. While visitation is tied to a specific spring location, visitors may spend money across county boundaries (e.g., purchasing food, fuel, or lodging in nearby counties). As a result, the county-level estimates presented in this report reflect the economic activity captured within each modeled county rather than the full spatial distribution of visitor spending across the broader region. This approach is consistent with standard input–output modeling practices but may result in some cross-county spillover effects not being fully attributed to the originating spring site. **These county-level economic contributions only include the springs in our study, as we used primary data from surveys at these sites. These do not include any private springs or other springs in certain counties.**

3.2.1.1 ALACHUA COUNTY

Table 4 presents the economic impacts associated with visitation to Poe Springs County Park in Alachua County. Results indicate that spring visitation supports approximately 1.7 jobs, generates $67,695 in labor income, contributes $128,350 in value added, and produces $214,223 in total output within the county. Direct effects account for the majority of these impacts, reflecting visitor spending within the local economy.

Corresponding tax impacts are modest but measurable, with total tax revenues estimated at approximately $35,461 annually (Table 5). These revenues are distributed across county, state, and federal levels, with state and federal taxes comprising the largest shares.

Table 5. Economic impact analysis for springs in Alachua County (Poe Springs County Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	1.27	$46,173.74	$86,851.06	$140,959.59
Indirect	0.22	$11,897.76	$20,398.42	$39,485.08
Induced	0.18	$9,623.89	$21,100.07	$33,778.43
Totals	1.67	$67,695.39	$128,349.55	$214,223.10

Table 6. Tax results for Alachua County spring (Poe County County Park)

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$1,427.35	$2,764.34	$3,173.02	$7,539.59	$11,648.19	$26,552.50
Indirect	$133.82	$259.33	$297.58	$753.62	$2,913.59	$4,357.95
Induced	$183.68	$355.81	$408.37	$1,029.45	$2,573.41	$4,550.71
Totals	$1,744.85	$3,379.47	$3,878.97	$9,322.66	$17,135.19	$35,461.16

3.2.1.2 COLUMBIA COUNTY

In Columbia County, the spring represented is Rum Island Springs County Park (Table 6). Total impacts include approximately 47 jobs, $1.71 million in labor income, $3.21 million in value added, and $5.58 million in total output. Direct visitor spending accounts for the majority of employment and output, while indirect and induced effects provide additional contributions through supply-chain linkages and household spending.

Fiscal impacts associated with visitation in Columbia County total approximately $981,000 annually, with the largest shares accruing to federal and state governments (Table 7). County-level tax revenues also represent a meaningful component of these impacts.

Table 7. Economic impact analysis for springs in Columbia County (Rum Island Springs County Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	38.10	$1,335,964.09	$2,498,736.74	$4,168,205.05
Indirect	5.54	$225,226.81	$359,859.69	$822,028.07
Induced	3.44	$150,474.77	$350,316.55	$584,881.35
Totals	47.08	$1,711,665.67	$3,208,912.99	$5,575,114.47

Table 8. Tax results for springs in Columbia County (Rum Island Springs County Park).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$27,690.74	$44,983.55	$110,105.51	$275,637.28	$346,310.77	$804,727.84
Indirect	$2,184.21	$3,550.63	$8,686.33	$22,187.73	$55,416.04	$92,024.95
Induced	$2,444.16	$3,971.15	$9,718.97	$25,237.27	$42,393.83	$83,765.38
Totals	$32,319.12	$52,505.33	$128,510.81	$323,062.27	$444,120.65	$980,518.17

3.2.1.3 GILCHRIST COUNTY

Gilchrist County experiences the largest economic impacts among the counties examined, as the springs represented were Hart Springs County Park and Blue Springs State Park (Table 8).

Total impacts include approximately 288 jobs, $6.44 million in labor income, $13.23 million in value added, and $26.32 million in total output. Direct effects dominate these results, accounting for the majority of employment and output generated by visitor spending.

Tax revenues associated with spring visitation in Gilchrist County are estimated at approximately $5.0 million annually, with substantial contributions to county, state, and federal tax bases (Table 9). These results underscore the central role of springs visitation in supporting the local economy and public revenues in the county.

Table 9. Economic impact analysis for springs in Gilchrist County (Hart Springs County Park, Blue Springs State Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	253.36	$5,266,591.39	$10,960,251.82	$20,775,010.84
Indirect	28.25	$982,808.89	$1,597,986.10	$4,385,954.85
Induced	6.10	$192,329.09	$671,169.62	$1,163,012.59
Totals	287.70	$6,441,729.37	$13,229,407.54	$26,323,978.28

Table 10. Tax results for springs in Gilchrist County (Hart Springs County Park, Blue Springs State Park).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$117,322.30	$543,213.95	$1,169,293.33	$980,517.07	$1,590,348.38	$4,400,695.03
Indirect	$6,915.72	$32,031.25	$68,937.40	$60,650.08	$265,122.69	$433,657.14
Induced	$3,268.35	$15,133.59	$32,574.89	$30,275.17	$69,757.96	$151,009.97
Totals	$127,506.36	$590,378.79	$1,270,805.62	$1,071,442.33	$1,925,229.04	$4,985,362.14

3.2.1.4 LAFAYETTE COUNTY

Economic impacts associated with spring visitation to Lafayette Blue Springs State Park and Troy Springs State Park in Lafayette County are comparatively small but nontrivial (Table 10). Total impacts include approximately 1.1 jobs, $25,539 in labor income, $50,652 in value added, and $95,967 in total output. As in other counties, direct effects account for the largest share of these impacts.

Total tax revenues generated by visitation in Lafayette County are estimated at approximately $16,094 annually, with revenues distributed across local, state, and federal jurisdictions (Table 11).

Table 11. Economic impact analysis for all springs in Lafayette County (Lafayette Blue Springs State Park, Troy Springs State Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	1.05	$21,704.05	$42,845.09	$80,022.87
Indirect	0.07	$3,036.01	$4,531.21	$10,913.60
Induced	0.02	$799.29	$3,275.60	$5,031.00
Totals	1.14	$25,539.35	$50,651.90	$95,967.47

Table 12. Tax results for all springs in Lafayette County (Lafayette Blue Springs State Park, Troy Springs State Park).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$242.77	$1,267.25	$2,895.71	$3,744.31	$5,992.23	$14,142.26
Indirect	$13.62	$71.14	$162.52	$213.60	$741.76	$1,202.64
Induced	$13.05	$68.10	$155.62	$212.65	$299.80	$749.22
Totals	$269.44	$1,406.49	$3,213.85	$4,170.55	$7,033.79	$16,094.12

3.2.1.5 LEVY COUNTY

In Levy County, spring visitation to Fanning Springs State Park supports an estimated 30 jobs, $791,268 in labor income, $1.62 million in value added, and $3.08 million in total output (Table 12). Direct effects again represent the dominant source of economic activity, with indirect and induced effects contributing additional impacts through inter-industry transactions and household spending.

Associated tax revenues total approximately $576,000 annually, with the largest shares accruing to state and federal governments, followed by county-level revenues (Table 13).

Table 13. Economic impact analysis for all springs in Levy County (Fanning Springs State Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	25.60	$625,496.24	$1,272,166.07	$2,324,900.16
Indirect	3.37	$127,625.50	$225,018.56	$552,076.46
Induced	1.15	$38,146.07	$124,149.67	$203,789.22
Totals	30.13	$791,267.80	$1,621,334.30	$3,080,765.83

Table 14. Tax results for all springs in Levy County (Fanning Springs State Park).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$19,050.40	$39,431.39	$91,856.50	$150,635.97	$182,764.69	$483,738.95
Indirect	$1,596.05	$3,304.48	$7,695.01	$13,006.80	$35,221.79	$60,824.12
Induced	$1,118.88	$2,315.94	$5,394.94	$9,242.44	$13,048.76	$31,120.97
Totals	$21,765.32	$45,051.81	$104,946.45	$172,885.22	$231,035.24	$575,684.04

3.2.1.6 SUWANNEE COUNTY

Table 14 reports economic impacts for Suwannee County, where spring visitation to Wes Skiles Peacock Springs State Park supports approximately 59 jobs, generates $2.01 million in labor income, contributes $3.82 million in value added, and produces $6.78 million in total output. Direct visitor spending accounts for the majority of these impacts, while indirect and induced effects provide meaningful additional contributions.

Total tax revenues associated with spring visitation in Suwannee County are estimated at approximately $1.28 million annually, with substantial contributions to federal and state tax revenues and additional benefits accruing at the county level (Table 15).

Table 15. Economic impact analysis for all springs in Suwannee County (Wes Skiles Peacock Springs State Park).

Impact	Employment	Labor Income	Value Added	Output
Direct	49.46	$1,605,040.55	$2,985,711.77	$5,109,535.19
Indirect	6.55	$265,761.00	$464,441.54	$1,072,961.80
Induced	3.34	$143,981.98	$373,144.65	$602,311.62
Totals	59.36	$2,014,783.53	$3,823,297.97	$6,784,808.60

Table 16. Tax Results for all springs in Suwannee County (Wes Skiles Peacock Springs State Park).

Impact	Sub County General	Sub County Special Districts	County	State	Federal	Total
Direct	$28,071.19	$57,323.82	$143,089.84	$357,226.52	$462,854.97	$1,048,566.33
Indirect	$2,751.83	$5,621.14	$14,027.22	$35,648.36	$74,703.24	$132,751.78
Induced	$2,333.39	$4,765.20	$11,894.21	$30,750.42	$46,240.61	$95,983.83
Totals	$33,156.40	$67,710.16	$169,011.26	$423,625.30	$583,798.82	$1,277,301.94

3.3 IMPLICATIONS

The economic contribution results documented in this section carry several implications for county-level environmental management. Taken together, visitor expenditures at the fifteen publicly managed springs in the study region support an estimated 427 jobs, $11.1 million in labor income, $22.1 million in regional GDP, and $7.9 million in tax revenues annually. **These figures represent activity that is directly tied to spring condition: degradation in water quality, flow, or on-site amenities that reduces visitation would reduce these economic contributions, while investments that maintain or improve conditions would help sustain them.** The economic case for spring protection is therefore not separable from the ecological case; they are the same case, expressed in different units.

The distribution of these contributions across counties is highly uneven and has implications for how spring-related economic benefits should be communicated at the local level. Gilchrist County alone accounts for approximately 288 jobs and $13.2 million in value added, driven by the combined visitation to Hart Springs and Gilchrist Blue Springs State Park. Suwannee and Columbia counties each host a single site in this study that supports tens of jobs and several million dollars in regional output. By contrast, Alachua and Lafayette counties show small modeled economic contributions from the springs included in this study, which reflects the fact that only Poe Springs (Alachua) and two smaller state parks (Lafayette) fall within those county study areas—not that springs are economically unimportant to those counties overall. For county environmental management agencies, these results are most useful as a floor on the economic activity supported by publicly managed springs within their jurisdiction.

The tax revenue results are particularly relevant for local government budgets. Visitor spending at springs supports an estimated $2.6 million in combined county and sub-county tax revenues annually across the study region, in addition to approximately $2.0 million in state and $3.2 million in federal revenues. These are recurring revenues that depend on continued visitation, and continued visitation depends on continued spring condition. From a public finance perspective, modest ongoing expenditures on spring protection and monitoring can be reasonably viewed as investments in the local tax base rather than as unrecovered costs.

Several limitations should inform how these numbers are used. Direct effects dominate the totals in every county, indicating that most spring-related economic activity is first-round visitor spending rather than deep local supply-chain multiplication; this is typical of nature-based recreation in rural economies where many intermediate inputs are imported from outside the county. The county-level study area convention also means that expenditures occurring across county lines are attributed to the county where they occur, not to the spring site that generated the trip, so individual county estimates may not fully capture the true draw effect of any particular spring. Finally, because privately owned springs are excluded and because Suwannee County Boating Use Attraction (SCBUA)-related activity is not incorporated, all figures in this section should be treated as conservative lower bounds on the full economic contribution of springs recreation in the region.

4. RECREATIONAL BENEFITS TO VISITORS

Florida's springs provide substantial recreational benefits to visitors that extend well beyond their direct expenditures on travel, lodging, and entrance fees. Economic contribution analysis captures how visitor spending circulates through local economies, but it does not measure the full value that individuals derive from their recreational experience. Consumer surplus — the difference between what a visitor is willing to pay to access a spring and what they actually spend — provides this complementary measure of public value. This section estimates consumer surplus for non-local spring visitors using a travel cost framework, in which the cost of travel serves as an implicit price for recreation and variation in trip frequency across visitors at different distances is used to infer the underlying demand function.

4.1 DATA SOURCES AND ANALYTICAL APPROACH

Data were collected through an on-site intercept survey administered at ten spring sites across the study area from January 2025 to August 2025. A stratified random sampling approach was used, with survey effort allocated across springs, days of the week, and time of day, and weighted toward higher-visitation periods to ensure proportional representation.

Survey respondents reported the number of trips taken to the spring in the previous 12 months, one-way travel distance and time, group size, trip purpose, household income, and socio-demographic characteristics. These data support construction of a per-person travel cost variable that captures both vehicle operating expenses and the opportunity cost of travel time.

4.1.1 TRAVEL COST CONSTRUCTION

Travel cost was constructed following the approach of Hwang et al. (2021), combining two components:

(1) **Vehicle operating cost:** Round-trip distance was multiplied by a per-mile vehicle cost of \$0.67 (IRS 2024 standard mileage rate), then divided by group size to obtain per-person cost.

(2) **Time cost:** Round-trip travel time was multiplied by one-third of the visitor's imputed hourly wage (annual household income divided by 2,080 working hours), following the standard one-third wage rate assumption (Cesario, 1976). Per-person time cost was derived by dividing by group size.

Where respondents provided only one of distance or time (not both), the missing dimension was imputed assuming an average travel speed of 60 miles per hour, consistent with Florida highway conditions. Cases where neither was available were excluded from the model.

4.1.2 SAMPLE AND MODEL SPECIFICATION

Consumer surplus estimation was restricted to non-local visitors — those traveling from more than 20 miles outside the spring location — for two reasons. First, TCM assumptions require that travel cost vary meaningfully across respondents, which is less true for nearby residents who visit springs as a routine local amenity. Second, interaction modeling confirmed that local residents are not statistically sensitive to travel cost ($p > 0.10$), making consumer surplus estimation unreliable for this group.

The primary model was estimated using a negative binomial regression with the annual trip count as the dependent variable, consistent with count data having overdispersion (variance-to-mean ratio substantially greater than one). An endogenous stratification correction (Shaw, 1988) was also estimated to account for the over-representation of frequent visitors in on-site intercept samples. Full model specification details, variable descriptions, and estimation results are provided in Appendix D. Sensitivity analyses using an expanded sample and alternative model specifications are presented in Appendix F.

4.2 SAMPLE CHARACTERISTICS

The intercept survey collected responses from visitors across ten spring sites. Survey respondents were predominantly non-local: approximately 81% traveled from outside the immediate local area, including both in-state visitors from more than 20 miles away (71.2%) and out-of-state visitors (9.9%). The sample used for consumer surplus estimation (non-local visitors only) comprised 73 respondents. Average reported household income was $93,688, mean age was 44 years, and respondents were roughly evenly split by gender.

Spring visitation was primarily motivated by nature appreciation, relaxation, and social connection. Mean motivation scores on a 5-point Likert scale were highest for enjoying scenery (4.73), experiencing nature (4.73), being close to nature (4.68), and relaxing physically (4.67). Most visits were primary-purpose trips (80.2%), and average group size was 5.5 people.

4.3 CONSUMER SURPLUS ESTIMATES

The travel cost coefficient was negative and statistically significant in the primary model (coefficient = −0.092, SE = 0.034, $p < 0.05$), confirming that visitation declines as travel costs increase, consistent with demand theory. Based on this coefficient, consumer surplus per trip is estimated at $10.97 for the standard negative binomial model.

When adjusted for endogenous stratification — accounting for the over-representation of frequent visitors in the on-site sample — the consumer surplus estimate is $8.40 per trip. This conservative estimate is more appropriate for policy applications because it corrects for a known sampling bias inherent in intercept surveys. Both estimates are statistically supported, with travel cost coefficients significant at the 5% and 10% levels respectively.

Table 17. Travel Cost Model Results for Non-Local Visitors (N = 73)

	Coefficient	Std. Error	Coefficient	Std. Error
	Standard Model		**Endogenous Stratification**	
Total Travel Cost	-0.092**	0.034	-0.119*	0.049
Longer Trip	0.314	0.539	0.487	0.688
Primary Purpose	-0.201	0.824	-1.375	0.950
Solitude & Equipment Motivation	0.663**	0.247	0.971**	0.308
Be in Nature & Relaxation	-0.083	0.191	-0.067	0.203
Exercise & Health	0.193	0.199	0.013	0.232
Family Motivation	-0.215	0.309	-0.043	0.333
Female	0.551	1.140	-1.480	1.132
Education (lower/college)	0.223	0.396	0.370	0.472
Household income	0.002	0.003	-0.006	0.003
Age	0.028	0.023	0.029	0.025
Full-time employed	-0.434	0.579	-0.611	0.802
Part-time employed	-0.131	0.555	-0.287	0.706
Student	0.141	0.825	0.040	1.029
Group size	0.011	0.014	0.026	0.017
Facilities rating	-0.030	0.219	-0.061	0.254
Water quality rating	-0.035	0.298	-0.424	0.399
Crowding rating	0.016	0.203	0.247	0.262
Constant	1.881	2.297	4.776	2.791
Log-likelihood	-130.90		-106.52	
Pseudo R^2	0.071		0.094	
N	73		73	
Consumer surplus per trip	**$10.97**		**$8.40**	
Total annual CS (930,555 non-local visitors)	$10,208,188		$7,816,662	

Note. Primary model estimated using negative binomial regression (nbreg) with annual trips to the spring as the dependent variable. Endogenous stratification model applies the Shaw (1988) correction for on-site sampling bias. ** $p < 0.01$, * $p < 0.05$.

4.4 AGGREGATE ANNUAL RECREATIONAL BENEFITS

To estimate total annual recreational benefits, consumer surplus per trip is scaled to the estimated number of annual non-local visitor days. Based on intercept survey data, approximately 81% of spring visitors are non-local. Applying this proportion to total 2024 visitation of approximately 1,148,833 visitor-days yields an estimated 930,555 annual non-local visitor days.

Multiplying consumer surplus per trip by this visitation estimate produces aggregate annual recreational benefit estimates as follows:

Table 18.Estimated Annual Recreational Benefits from Spring Visitation (2024)

Estimate	CS per trip	Total annual value
Standard model (primary estimate)	$10.97	$10,208,188
Endogenous stratification / Shaw correction (conservative)	$8.40	$7,816,662
Vehicle cost only — sensitivity check (lower bound)	$58.15*	Not reported†

Note. * Statistically significant (p = 0.018) but uses vehicle cost only, excluding time cost — therefore not directly comparable to the primary estimates. † The $58.15 vehicle-cost-only estimate reflects a different cost definition and cannot be aggregated using the same denominator as the full-cost models.

These values represent the net recreational welfare generated by spring visitation above and beyond actual visitor spending. They are not captured in expenditure-based economic impact analyses and represent a distinct and complementary measure of public benefit.

4.5 VALUE OF IMPROVEMENTS IN SPRING CONDITIONS

In addition to current recreational value, the survey collected stated-preference responses about how visitors' trip frequency would change under hypothetical improvements to spring conditions. Respondents indicated they would take substantially more trips if crowding were reduced (mean additional trips = 43.65, SD = 73.67), water quality improved (mean = 38.56, SD = 64.69), or facilities were improved (mean = 33.45, SD = 61.66).

Translating these stated increases in trips into consumer surplus terms using the primary travel cost coefficient ($10.97/trip) suggests that crowding reduction alone could increase annual recreational value per non-local visitor by approximately $480, and water quality improvement by approximately $423. These estimates are subject to substantial uncertainty, including hypothetical bias inherent in stated preference methods and the influence of extreme responses. However, they directionally confirm that investments in spring water quality and visitor management generate measurable increases in public recreational welfare.

4.6 INTERPRETATION AND IMPLICATIONS

The consumer surplus estimates presented here demonstrate that Florida's springs generate substantial non-market recreational value that is not captured in visitor spending data alone. For every dollar a non-local visitor spends traveling to a spring, they receive an estimated $8.40 to $10.97 in additional welfare benefit. Aggregated across annual visitation, this represents $7.8 million to $10.2 million per year in net recreational benefit to visitors.

These benefits are directly tied to spring condition. Declines in water quality, reductions in flow, or increases in crowding have the potential to reduce both visitation and consumer surplus, while restoration investments that improve environmental conditions can generate measurable increases in public welfare. For agencies evaluating conservation investments, these estimates provide a non-market economic basis for benefit-cost comparisons alongside expenditure impacts, ecosystem service values, and public support data documented elsewhere in this report.

The sensitivity analyses in Appendix F, while not statistically significant at conventional levels, are directionally consistent with the primary estimates and reinforce the conclusion that spring recreation generates positive and meaningful consumer welfare. The substantial width of the confidence intervals in those models reflects the inherent challenge of estimating recreation demand from a relatively small on-site sample with high variance in trip frequency — a limitation shared across most travel cost studies of this type.

5. ECOSYSTEM SERVICES VALUATION

Spring systems in North-Central Florida provide a wide range of ecosystem services that contribute to both environmental quality and human well-being. These services include regulating functions such as water purification and flood mitigation, as well as supporting and cultural services such as carbon storage and aesthetic value. While these benefits are not directly captured in market transactions, they represent real economic value and are critical to understanding the full contribution of spring systems to regional economies and ecosystems.

Traditional economic analyses often focus on observable market activity, such as visitor expenditures or employment impacts. However, this approach captures only a portion of the total value generated by natural systems. Ecosystem service valuation expands this perspective by quantifying the non-market benefits provided by natural landscapes. In the context of Florida's springs, many of these benefits are generated not only at the spring vent itself, but across the surrounding landscape that supports hydrological function, water quality, and ecological integrity (Boyd & Krupnick, 2009; U.S. EPA, 2016).

This section estimates the annual economic value of ecosystem services generated by lands associated with springs in the Lower Suwannee and Santa Fe River basins. By doing so, it provides a more comprehensive assessment of the benefits of spring systems and highlights the importance of landscape-scale conservation and management.

5.1 DATA SOURCES AND ANALYTICAL APPROACH

5.1.1 OVERVIEW OF VALUATION FRAMEWORK

Ecosystem service values were estimated using a benefit transfer methodology, which applies monetary values derived from existing studies to comparable ecological contexts within the study area. This approach is widely used in environmental economics and is considered appropriate when primary valuation studies are not feasible due to constraints on time, data, or resources.

The validity of benefit transfer depends on the degree of similarity between the study context and the original valuation studies. In this analysis, care was taken to select valuation estimates from peer-reviewed literature and government sources that reflect ecological conditions similar to those found in Florida's spring systems, including comparable climate, land cover types, and hydrological characteristics. Where necessary, values were standardized to ensure consistency in units (e.g., dollars per acre per year) and temporal scale.

A key conceptual foundation of this analysis is that ecosystem services are produced by landscape processes, rather than by individual points such as spring vents. As a result, the valuation framework emphasizes the role of surrounding land cover, particularly forests and wetlands, in generating ecosystem services.

5.1.2 SPATIAL SCOPE AND UNITS OF ANALYSIS

To capture ecosystem service provision at different spatial scales, we examined two different area scales to capture both localized and landscape level ecosystem service values.

First, 5-mile buffers around individual springs were used to represent localized zones of influence. Spring point locations were drawn from the SPA dataset (see below) and buffered to 5 miles in ArcGIS Pro. This spatial unit provides insight into how land use in the immediate vicinity of springs contributes to ecosystem service generation and aligns with commonly used management and planning boundaries (Figure 2).

Second, Spring Protection Areas (SPAs)—the Florida Geological Survey boundaries delineating the broader areas of land that contribute flow to Florida springs, published by the Florida Department of Environmental Protection (FDEP) as a resource for land-use decision-making—were used to represent broader hydrologically connected landscapes (Figure 3 and 4). SPAs encompass recharge areas and upstream regions that influence groundwater flow, water quality, and ecological function at the spring. This scale is more consistent with the ecological processes that sustain spring systems over time.

It is worth distinguishing Spring Protection Areas from a related FDEP designation that is sometimes confused with them: Priority Focus Areas (PFAs). Although both are FDEP products related to spring protection, they are different layers, created for different purposes, and used here for different reasons.

Spring Protection Areas (SPAs) are a Florida Geological Survey product, published by FDEP, that map the broader areas of land contributing flow to Florida springs. They are intended as a published resource for land-use decision-makers working to protect both the quantity and quality of water discharging from springs, and they cover a wide range of major springs across the state regardless of impairment status. Priority Focus Areas (PFAs), by contrast, are statutory regulatory boundaries delineated under the Florida Springs and Aquifer Protection Act and incorporated into Basin Management Action Plans (BMAPs). PFAs are delineated only for impaired Outstanding Florida Springs, are narrower in extent than SPAs, and emphasize aquifer vulnerability and groundwater connectivity rather than broader spring-contribution geography. PFAs trigger specific regulatory requirements within their boundaries (such as restrictions on new septic systems and fertilizer-use ordinances), whereas SPAs are advisory rather than regulatory.

This study uses the SPA layer, not the PFA layer, for the landscape-scale analysis. The SPA layer was the appropriate choice for an ecosystem-services framing because it captures the broader contribution areas where landscape composition (forests, wetlands, marshes) drives ecosystem service value, and because it provides consistent coverage across all the springs in the study area rather than only those formally designated as impaired. Spring point locations within the SPA dataset were then used as centers for the 5-mile buffers described above, ensuring that the two spatial units in this analysis are derived from a common, FDEP-published source.

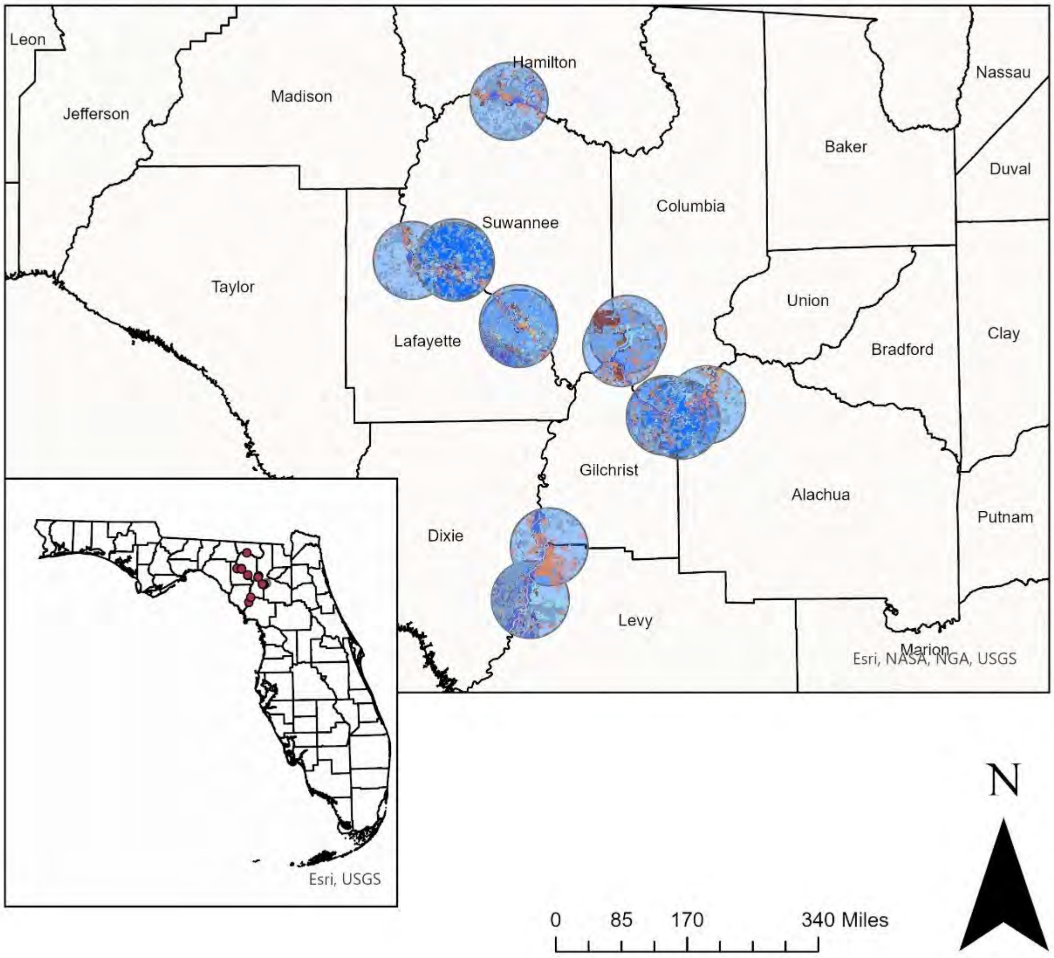

Figure 2. 5-mile buffers with ecosystem type for springs in sample (created using ArcGIS Pro).

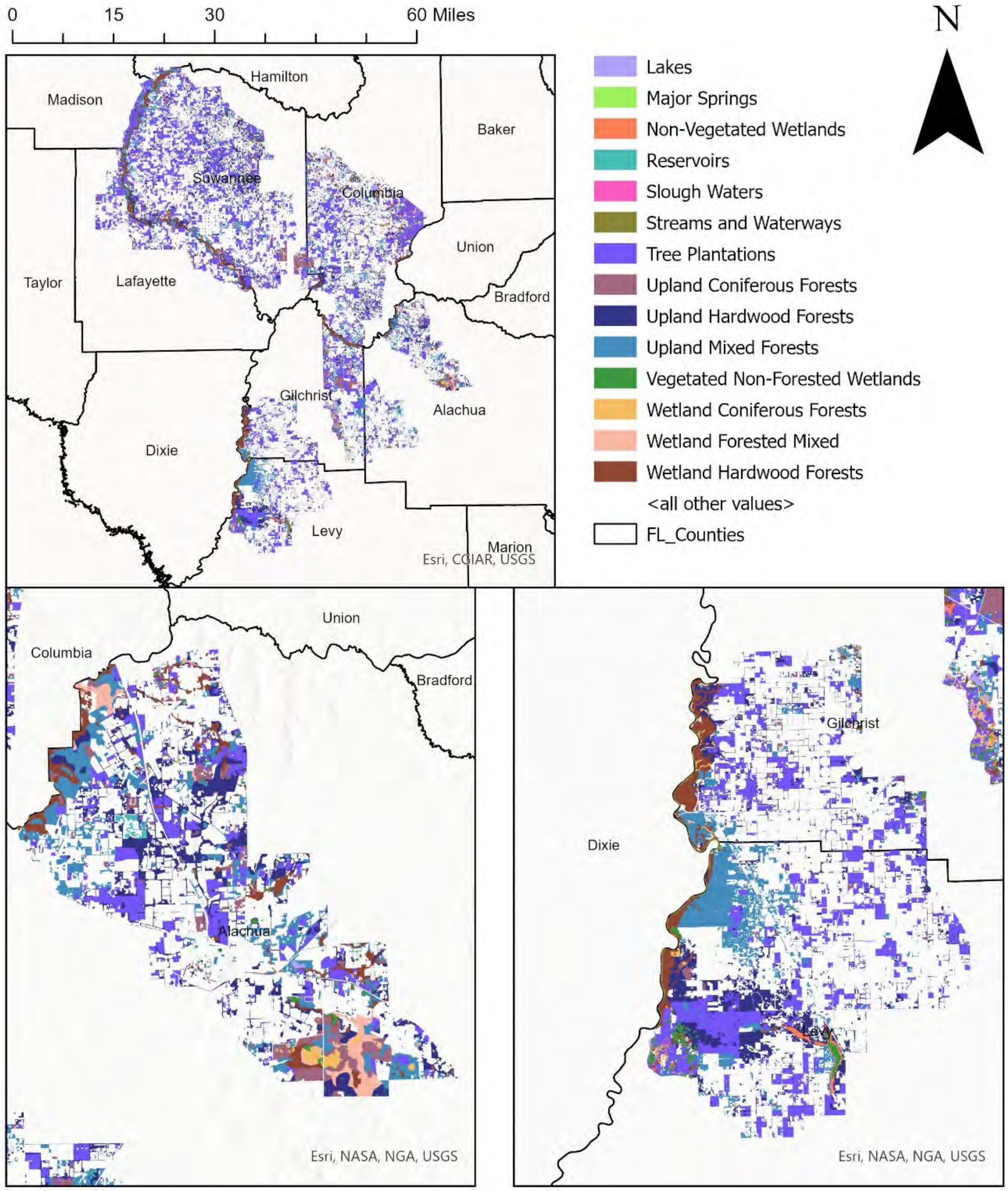

Figure 3. Springs Protection Areas (SPAs) with ecosystem types. (Top: all 5 SPAs; Bottom left: Columbia, Hornsby, Treehouse; Bottom right: Fanning, Manatee).

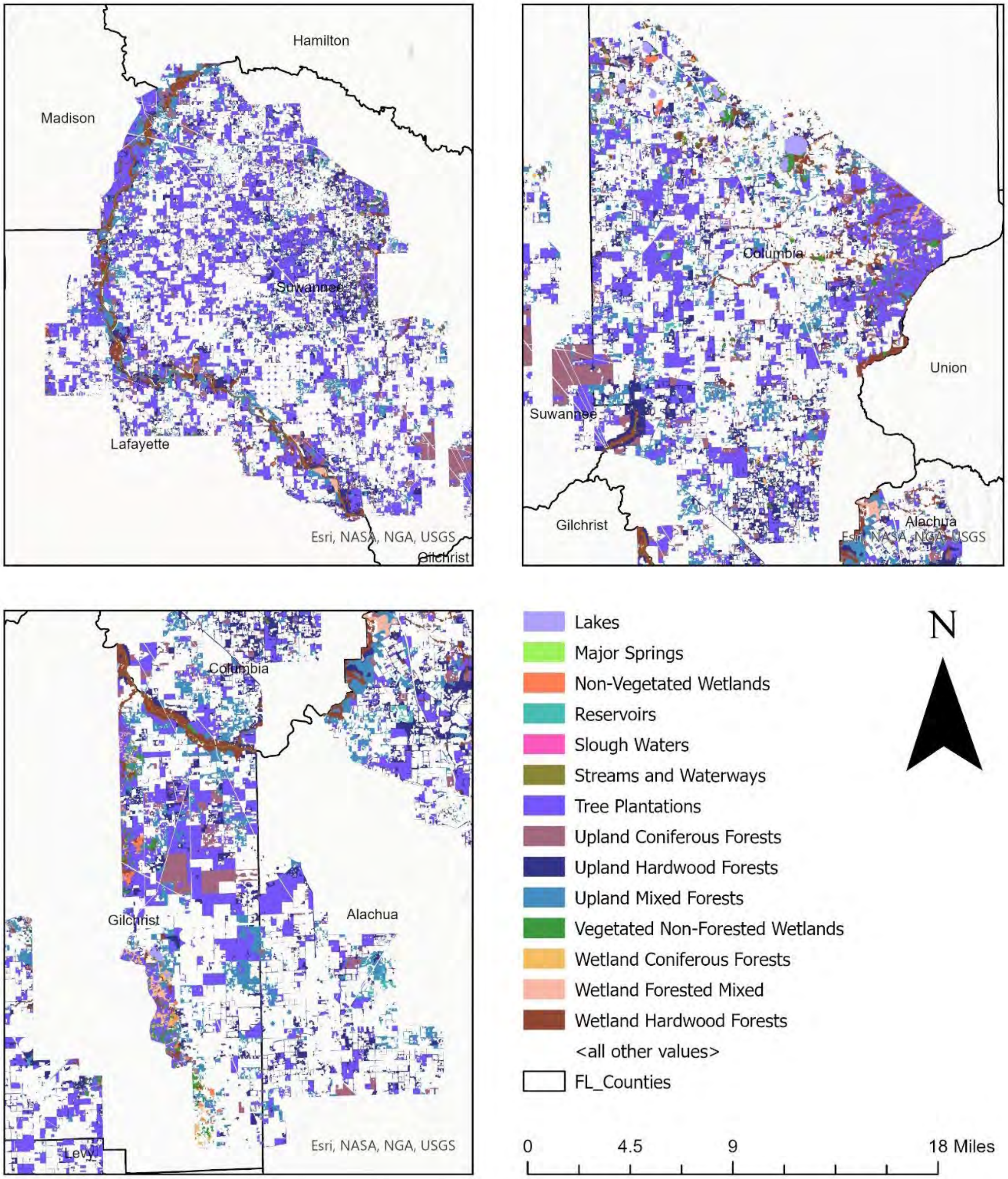

Figure 4. Springs Protection Areas (SPAs) with ecosystem type (Top right: Troy, Peacock, Lafayette Blue, Falmouth; Top left: Ichetucknee; Bottom left: Devil's Ear).

5.1.3 LAND COVER DATA AND SPATIAL ANALYSIS

Land cover data were obtained from the Florida Land Use, Cover and Forms Classification System (FLUCCS), which provides detailed spatial information on land use and vegetation types across the study region. These data were processed using geographic information system (GIS) tools to delineate land cover within both the 5-mile buffers and Spring Protection Areas.

Individual FLUCCS categories were aggregated into broader ecosystem types relevant for valuation, including forested lands, wetlands, agricultural lands, developed areas, and open water. This aggregation facilitates the application of per-acre ecosystem service values while maintaining ecological relevance.

For each spatial unit, total acreage of each ecosystem type was calculated. These acreage estimates form the basis of the valuation analysis, as ecosystem service values are applied on a per-acre basis. Differences in land cover composition and total acreage across springs and SPAs are a primary driver of variation in ecosystem service values.

Detailed land cover classifications and acreage estimates are provided in Appendix D (Tables D1–D2).

5.1.4 ECOSYSTEM SERVICES INCLUDED

The analysis focuses on four ecosystem services that are particularly relevant to spring systems and for which reliable valuation estimates are available:

Water Quality Improvement:
Natural landscapes, particularly wetlands and forests, play a critical role in filtering nutrients, sediments, and pollutants from water before they reach springs and connected waterways. This service helps maintain water clarity, supports aquatic ecosystems, and reduces the need for costly water treatment.

Carbon Sequestration:
Vegetation and soils store carbon over time, reducing atmospheric carbon dioxide concentrations and contributing to climate regulation. Forested areas, in particular, provide significant carbon storage capacity.

Flood Attenuation:
Wetlands and floodplain areas absorb and store excess water during high-flow events, reducing flood risk downstream. This service is especially important in regions with variable rainfall and increasing development pressure.

Water Clarity and Aesthetic Value:
Clear water and intact natural landscapes provide aesthetic and cultural benefits that enhance recreation, tourism, and overall quality of life.

These services were selected to reflect a combination of ecological importance and data availability. Other services, such as biodiversity support and groundwater recharge, are also important but were not included due to limitations in available valuation data.

5.1.5 VALUATION METHODOLOGY AND ASSUMPTIONS

Per-acre values for each ecosystem service were obtained from published studies and applied to the corresponding land cover acreage within each spatial unit (Table X). The general valuation approach can be expressed as:

Total Ecosystem Service Value = Σ (Acreage of land cover type × Value per acre for that service)

This approach assumes that ecosystem service provision is proportional to land area and that per-acre values are transferable across similar ecological contexts. To account for uncertainty in valuation estimates, we used low (conservative), central, and high estimates. We present low estimates to avoid overstating ecosystem service values and to provide a conservative basis for policy discussion. Central and high estimates are presented in Appendix D for comparison.

Key assumptions include:

- Ecosystem service values are constant within each land cover category
- Land cover classification accurately reflects ecological function
- Values from source studies are applicable to the study region

Table 19. FLUC ecosystem group, ecosystem service, assumptions, and sources to estimate per acre values.

FLUC ecosystem group	Ecosystem service	Unit	Low	Central	High	Basis / assumptions	Key sources
Freshwater wetlands (FLUC 600s)	Water quality (nutrient removal)	$/acre/year	300	850	1500	Derived using (a) SE U.S. wetland nutrient removal efficiencies and (b) nutrient reduction cost benchmarks (e.g., $/lb N or $/kg P removed; constructed treatment wetland O&M and removal costs).	Isik et al. 2023; Dunne et al. 2015; U.S. EPA 2015
Freshwater wetlands (FLUC 600s)	Carbon sequestration (soil + biomass)	$/acre/year	120	250	450	Carbon sequestration rates reported for Florida wetlands converted to CO2e and valued using SCC (low/central/high SCC assumptions).	Villa et al. 2015; U.S. EPA 2023 (SC-GHG)
Freshwater wetlands (FLUC 600s)	Flood attenuation & water regulation	$/acre/year	200	600	1200	Based on empirical estimates linking wetland area to reduced flood insurance claims / flood damages (annualized benefit), scaled to per-acre terms.	Taylor & Ortenzi 2021 (RFF); Taylor & Ortenzi 2022 (AER); FEMA 2022
Riparian forest buffers (typ. FLUC 411/412)	Water quality (nutrient filtering)	$/acre/year	250	700	1400	Derived from buffer nitrate reduction/denitrification ranges combined with nutrient reduction cost benchmarks ($/lb N removed).	King et al. 2016; U.S. EPA 2015
Riparian forest buffers (typ. FLUC 411/412)	Carbon sequestration	$/acre/year	90	180	350	Bottomland/riparian forest CO2 sequestration rates (SE U.S. examples) valued using SCC (range).	Texas Coastal Exchange 2020; U.S. EPA 2023 (SC-GHG)
Upland forest (pine/hardwood; FLUC 400s)	Carbon sequestration	$/acre/year	40	90	180	Forest carbon accumulation rates (U.S., with relevance to fast-growing Southeast) converted to CO2e and valued using SCC.	USFS 2007 (Smith et al.); U.S. EPA 2023 (SC-GHG)
Open water / springs (FLUC 510–520)	Water quality & clarity support (proxy)	$/acre/year	150	400	900	Proxy values anchored to Florida springs recreation and restoration willingness-to-pay evidence; intended as a conservative placeholder where per-acre clarity values are needed.	Wu et al. 2018; UF/IFAS EDIS FE959

Notes on Valuation Sources: (1) Nutrient removal values were developed using wetland and riparian nutrient reduction rates, combined with Florida- and EPA-derived benchmarks for nutrient control costs in dollars per pound of nitrogen or phosphorus reduced (1e.g., constructed treatment wetlands, stormwater BMPs), (2) Carbon sequestration values were based on published estimates of annual carbon uptake rates (in tons CO_2 per acre), with monetary values applied using the Social Cost of Carbon (SC-GHG) from the U.S. EPA (2023). The SCC used ranged from $56 (low) to $190 (high) per metric ton CO_2e, reflecting varying discount rates, (3) Flood attenuation values were derived from studies linking wetland area to reductions in downstream flood damage and FEMA-insured losses. Taylor & Ortenzi (2021, 2022) developed empirical models linking wetland coverage to annualized avoided costs in Southeastern U.S. watersheds, and (4) Open water values represent a proxy estimate for aesthetic and recreational services linked to water clarity. These are based on willingness-to-pay studies conducted in Florida springsheds, particularly those estimating economic benefits from spring restoration or reduced turbidity

5.2 ECOSYSTEM SERVICES VALUATION RESULTS

5.2.1 INDIVIDUAL SPRINGS (5-MILE BUFFERS)

Across all springs included in the analysis, ecosystem services generated within 5-mile buffers exceed $37.5 million annually (low estimate). These values reflect the combined contributions of multiple ecosystem services across diverse land cover types.

Carbon sequestration represents the largest component of total value, contributing approximately $18.7 million per year, followed by water quality improvement at approximately $15.7 million per year. Together, these two services account for the majority of total ecosystem service value, highlighting the importance of forested and wetland ecosystems.

Flood attenuation contributes approximately $2.0 million annually, reflecting the role of wetlands and floodplain areas in regulating water flow. Water clarity and aesthetic benefits contribute an estimated $1.1 million annually, capturing non-market benefits associated with environmental quality.

There is considerable variation in ecosystem service values across individual springs. This variation is driven primarily by differences in surrounding land cover. Springs located within landscapes dominated by forests and wetlands—such as Manatee Springs, Little River Spring, and Troy Spring—generate substantially higher ecosystem service values than those located in more developed or agricultural areas.

These findings indicate that the ecological condition and composition of surrounding lands are critical determinants of ecosystem service value.

5.2.2 SPRING PROTECTION AREAS (SPAS)

When evaluated at the scale of Spring Protection Areas, total ecosystem service values exceed $175 million annually (low estimate). These higher values reflect the larger spatial extent of SPAs and the inclusion of hydrologically connected lands that contribute to ecosystem function.

The largest SPA in the study area (Troy–Peacock–Lafayette Blue–Falmouth) generates over $123 million annually, with particularly high contributions from carbon sequestration ($45.3 million) and water quality improvement ($47.1 million).

Table 20. Ecosystem types in acres for each spring within the 5-mile buffer method.

Spring Name	Upland forest	Open water/springs	Forested wetlands/swamps	Marsh/wet prairie/aquatic vegetation
Manatee Spring	28,339	992	8,506	3,071
Suwannee Blue Spring	26,063	491	5,707	651
Coffee Spring	25,875	308	1,647	136
Ichetucknee Springs	25,606	310	916	56
Gilchrist Blue Spring	23,464	274	3,263	295
Rum Island Spring	23,201	287	3,222	251
Poe Woods Spring	22,313	278	2,561	58
Poe Spring	22,096	272	2,632	65
Little River Spring	21,705	746	5,829	2,766
Hornsby Spring	21,392	371	3,055	35
Lafayette Blue Spring	21,326	570	2,466	195
Troy Spring	21,198	746	4,945	2,136
Fanning Spring	20,624	989	4,089	326
Peacock State Park	20,442	438	1,783	60
TOTAL	323,644	7,072	50,621	10,101

Table 21 summarizes the types of land found within officially designated Spring Protection Areas, which cover broader regions identified for spring protection and management. As with the 5-mile buffers, upland forests dominate these areas across all spring systems, indicating that most protected spring landscapes are largely forested. Forested wetlands and marshes also make up a substantial share of land in several protection areas, especially in the Troy–Peacock, Fanning–Manatee, and Devil's Ear systems. Differences in the amount of open water and spring features reflect variation in river networks and spring density among systems.

Table 21. Ecosystem type acreages for Springs Protection Areas.

Ecosystem Type	Troy Peacock LafayetteBlue Falmouth	Ichetucknee	Devil's Ear	Fanning Manatee	Columbia Hornsby Treehouse
Upland forest	684,765	140,235	61,262	65,290	10,296
Open water/springs	100,534	34,618	5,707	4,664	1,347
Forested wetlands/swamps	91,243	39,273	10,515	6,157	1,751
Marsh/wet prairie/aquatic vegetation	81,073	24,902	1,024	8,416	1,236

5.1.3 BENEFIT TRANSFER METHODOLOGY

Ecosystem service values were estimated using a benefit transfer methodology, which applies economic values derived from previously published studies and policy-relevant valuation tools to the current study context. This approach is widely accepted for environmental policy analysis, land-use planning, and resource management when primary valuation is infeasible due to time, budget, or data constraints, and when the objective is to generate screening-level or comparative estimates rather than site-specific welfare measures (Boyd & Krupnick, 2009; U.S. EPA, 2016).

The benefit transfer framework used in this study applies per-acre-per-year monetary values to mapped ecosystem acreage within defined spatial units (5-mile buffers and Spring Protection Areas). Values were drawn from peer-reviewed literature, federal guidance documents, and regionally relevant studies focused on Florida or the southeastern United States. Where necessary, biophysical ecosystem service rates were combined with economic unit values to derive monetary estimates. All values are reported in 2023 U.S. dollars.

Per-acre values were developed separately for each ecosystem service and ecosystem type. Values were specified as low, central, and high estimates to reflect uncertainty in ecological performance, valuation assumptions, and spatial heterogeneity (Table 28).

5.1.3.1 WATER QUALITY SERVICES (NUTRIENT REMOVAL AND FILTERING)

Water quality benefits were estimated for freshwater wetlands and riparian forest buffers, reflecting their documented capacity to reduce nutrient loads through sediment retention, plant uptake, and denitrification processes. Per-acre nutrient removal values for wetlands were derived by combining reported nutrient reduction efficiencies from southeastern U.S. wetland systems with benchmark nutrient control costs expressed in dollars per unit of nutrient removed. These benchmarks are based on the costs of achieving equivalent nutrient reductions through engineered alternatives such as constructed treatment wetlands, stormwater best management practices, and wastewater treatment upgrades (Dunne et al., 2015; U.S. EPA, 2015; Isik et al., 2023).

For riparian forest buffers, nutrient filtering values were informed by empirical studies linking buffer vegetation and width to nitrate and sediment reduction, monetized using comparable nutrient reduction cost benchmarks (King et al., 2016; U.S. EPA, 2015). This avoided-cost approach reflects the replacement value of natural nutrient retention services provided by riparian ecosystems.

5.1.3.2 CARBON SEQUESTRATION (SOIL AND BIOMASS)

Carbon sequestration values were estimated for forested wetlands, riparian forests, and upland forests, based on published estimates of annual carbon uptake in both biomass and soils. Wetland carbon values reflect high rates of soil carbon accumulation under saturated conditions, while forest values reflect biomass growth and soil carbon dynamics typical of southeastern forest systems (Villa et al., 2015; Smith et al., 2007; Texas Coastal Exchange, 2020).

Biophysical carbon sequestration rates, reported in metric tons of carbon or CO_2e per acre per year, were monetized using the Social Cost of Greenhouse Gases (SC-GHG) published by the U.S. Environmental Protection Agency (EPA, 2023). Low, central, and high values correspond to alternative discount rate assumptions and represent uncertainty in long-term marginal climate damages.

5.1.3.3 FLOOD ATTENUATION AND WATER REGULATION

Flood attenuation and water regulation benefits were estimated for freshwater wetlands, reflecting their capacity to store floodwaters, reduce peak flows, and mitigate downstream flood damages. Per-acre values were derived from empirical studies that link wetland extent to reductions in flood insurance claims and FEMA-reported flood damages across southeastern U.S. watersheds. These studies estimate annualized avoided flood damages, which were converted to per-acre values suitable for benefit transfer (Taylor & Ortenzi, 2021; Taylor & Ortenzi, 2022; FEMA, 2022).

This avoided-cost framework is commonly used in ecosystem service valuation when regulating services reduce economic damages that would otherwise occur under alternative land-use scenarios.

5.1.3.4 WATER CLARITY AND AESTHETIC SERVICES (PROXY VALUES)

Water clarity and aesthetic benefits were estimated for open water and spring features using proxy per-acre values derived from willingness-to-pay studies conducted in Florida springsheds. These studies estimate economic benefits associated with improved water clarity, reduced turbidity, and enhanced recreational and scenic quality resulting from spring restoration or water quality improvements (Wu et al., 2018; UF/IFAS EDIS FE959).

Because direct per-acre aesthetic values for open water features are rarely reported, these estimates are intended as conservative proxies rather than precise measures of recreational demand. Values were applied uniformly across open water acreage to support comparative analysis across spatial units.

5.3 IMPLICATIONS

The ecosystem services valuation results carry several implications for how the public and private benefits of springs in the Lower Suwannee and Santa Fe River basins are understood, communicated, and managed. At the 5-mile buffer scale, springs in the study area generate ecosystem services worth at least $37.5 million annually under conservative assumptions, with carbon sequestration and water quality improvement accounting for the large majority of that value. At the broader Spring Protection Area scale, total annual value exceeds $175 million. These figures complement—rather than substitute for—the visitor expenditure and consumer surplus estimates reported in earlier sections, and together provide a more complete account of what the region’s springs are worth.

First, ecosystem service value is overwhelmingly produced by the land cover surrounding springs rather than by spring vents themselves. Forested uplands, forested wetlands, and marsh systems are the dominant contributors of carbon sequestration, nutrient retention, and flood attenuation. Springs embedded in landscapes dominated by these cover types—such as Manatee Springs, Little River Spring, and Troy Spring—generate substantially higher ecosystem service value than those embedded in more developed or agricultural settings. The practical implication for county and state managers is that spring protection cannot be separated from land conservation in the surrounding recharge basin: investments in fee acquisition, conservation easements, working-lands programs, and zoning that preserves forest and wetland cover are direct investments in spring value.

Second, the difference between the 5-mile buffer estimates and the Spring Protection Area estimates is itself informative. The roughly five-fold increase in total ecosystem service value at the SPA scale reflects the inclusion of hydrologically connected lands that influence groundwater quality and flow at the spring but lie well outside any locally apparent “spring zone.” This finding reinforces the case for landscape-scale planning frameworks—such as those embedded in the SPA designations themselves—rather than parcel-by-parcel or site-by-site management. Decisions made on lands distant from the spring vent, but within the recharge area, materially affect the value the spring generates.

Third, the dominance of carbon sequestration ($18.7 million at the buffer scale; $45.3 million in the largest SPA) and water quality improvement ($15.7 million; $47.1 million) in the total has direct relevance for funding strategies. Both service categories are increasingly recognized in payment-for-ecosystem-services programs, federal climate-resilience funding, and nutrient-credit markets. The estimates reported here can support applications to such programs and provide a defensible monetary basis for prioritizing protection of forested and wetland parcels within the study area. Flood attenuation and water clarity, while smaller in dollar terms, are tied to outcomes—reduced FEMA claims, recreational quality—that resonate with local audiences and may be more readily communicated in public outreach.

Several caveats should accompany these estimates. The valuation relies on benefit transfer from published per-acre values, which carries uncertainty in transferability across regions and ecosystem types; for this reason all headline figures use the low end of the published value ranges. Water clarity and aesthetic values are proxies applied uniformly across open water acreage rather than site-specific willingness-to-pay measures, and should be treated as illustrative rather than precise. Carbon values are sensitive to the social cost of greenhouse gases assumed, which is itself subject to ongoing policy revision. Despite these caveats, the central pattern—that ecosystem services from the surrounding landscape generate value of the same order of magnitude as direct visitor benefits, and at the SPA scale several times larger—is robust to reasonable changes in assumptions.

6. FRAMING EFFECTS ON PUBLIC SUPPORT FOR FLORIDA SPRINGS MANAGEMENT

A substantial body of environmental communication research has examined how message framing shapes public attitudes toward environmental problems and proposed solutions. Two framing dimensions are particularly relevant to resource management contexts: (1) the substantive content of the message (ecological versus economic), and (2) the valence of the frame (loss versus gain). Prospect theory suggests that individuals are more sensitive to potential losses than equivalent gains, which has motivated the use of loss frames in conservation messaging. However, empirical evidence for loss framing advantages in environmental contexts is mixed, and some research documents a backfire effect in which emphasizing losses triggers psychological reactance and reduces support.

Individual-level characteristics are also known to shape receptivity to environmental messaging. In particular, the New Ecological Paradigm (NEP) scale — a widely used measure of pro-environmental worldview — has consistently predicted support for environmental policies and regulations. Understanding how environmental orientation interacts with message framing is therefore relevant to designing effective communication strategies.

This study contributes to this literature by examining framing effects in the context of Florida springs management using a quasi-experimental online survey of Florida residents. The survey included a control condition and four experimental treatments varying message content (ecological vs. economic) and valence (loss vs. gain). Binary logistic regression with sociodemographic and attitudinal covariates was used to estimate the independent effects of each framing condition on stated support for a proposed management plan.

6.1 METHODS

6.1.1 STUDY DESIGN AND SAMPLE

Data were collected via an online survey administered through Qualtrics to a general population sample of Florida residents. The final analytical sample comprised N = 1,805 respondents after excluding one case with missing treatment assignment. Respondents were randomly assigned to one of five experimental conditions in approximately equal proportions (roughly 20% per condition): (0) a no-message control group; (1) an economic loss frame emphasizing the economic costs of inaction; (2) a neutral ecological message describing the ecological importance of springs; (3) an ecological message with explicit loss framing; and (4) an ecological message with explicit gain framing. In addition to the framing experiment, the survey included questions about recreation behaviors related to springs recreation, as well as where recreationists get information about the springs before, during, and after their visit to the springs. Table 1 presents the sociodemographic characteristics of the full sample.

Table 22.Sample Characteristics (N = 1,805)

Characteristic	n	%
Gender		
Male	843	46.7
Female	952	52.7
Other / non-binary	10	0.6
Age (mean code = 4.69, range 2-7)		
Race / ethnicity		
White	1,520	84.2
Black or African American	254	14.1
Asian	30	1.7
Other	66	3.7
Education (mean code = 3.80, range 1-6)		
Income (mean code = 2.93, range 1-5)		
Political affiliation (mean = 3.38, range 1-6)		
1-2 Very / somewhat liberal		
3 Moderate		
4-6 Very / somewhat conservative		
Springs familiarity (mean = 2.41, range 1-4)		
NEP score (mean = 3.29, range 1.67-4.50)		
Treatment group	1,805	
Control	371	20.5
Economic	351	19.4
Ecological (neutral)	361	20.0
Ecological + Loss	370	20.5
Ecological + Gain	352	19.5

Note. Cells reporting exact category counts require confirmation from the full codebook where values are listed as ordinal codes. Percentages may not sum to 100 due to rounding.

6.1.2 MEASURES

The primary dependent variable was binary support for the proposed springs management plan (1 = support, 0 = neutral or oppose), derived from the relevant SupportPlan item within each respondent's assigned treatment condition. Treatment group membership was captured in a single categorical variable (0-4) with the control group serving as the reference category in all models.

Covariates were organized into three blocks. Sociodemographic characteristics included gender, age, education, income, Hispanic ethnicity, race (dummy-coded with White as reference), and political affiliation (1-6 scale: very liberal to very conservative). Behavioral measures included visit frequency to Florida springs and self-reported familiarity with springs issues. Environmental worldview was measured using a 12-item version of the New Ecological Paradigm (NEP) scale, with items rated on a 5-point agreement scale and averaged to produce a composite score (range: 1.67-4.50, M = 3.29, SD = 0.40). Higher scores indicate a stronger pro-environmental worldview.

6.1.3 ANALYTICAL APPROACH

Two complementary logistic regression models were estimated. The primary model (Model 2) regressed binary support on treatment group indicators and the full covariate set, with the control group as reference. A base model without covariates (Model 1) established unadjusted treatment effects. A likelihood ratio test assessed whether adding covariates improved model fit. All models report odds ratios with standard errors.

A supplementary factorial model (Model 3) was estimated among experimental arm respondents only (n = 1,434; control excluded), using two binary predictors to decompose the experimental design: an ecological message indicator (ecol: 1 = ecological, 0 = economic) and a frame direction indicator (loss: 1 = loss, 0 = gain). An interaction term was tested but found to be non-significant and is not reported in the final model. Predicted probabilities were derived using the margins command with covariates held at their sample means. All analyses were conducted in Stata.

6.2 RESULTS

6.2.1 RECREATION CHARACTERISTICS, BEHAVIORS, AND SOURCES OF INFORMATION ABOUT SPRING

Respondents generally expressed a high likelihood of visiting a freshwater spring in the coming year (Table 32). Nearly seven in ten respondents (69.3%) reported being either somewhat likely (36.2%) or extremely likely (33.1%) to visit a spring, while only 14.4% indicated that they were unlikely to do so. The remaining 16.2% reported neither being likely nor unlikely.

Reported visitation frequency varied considerably across respondents. Over one-third of respondents (34.4%) indicated they had never visited a freshwater spring, while 24.7% reported visiting once a year or less. At the higher end of the distribution, 14.6% reported visiting multiple times per week, and an additional 8.9% reported visiting at least once per month. These results indicate a highly heterogeneous population that includes both infrequent visitors and highly engaged spring users.

Among respondents who visit springs, a wide range of recreational activities was reported. Swimming was the most commonly reported activity (60.2%), followed by wildlife viewing (52.9%). Photography (38.1%), hiking (31.1%), and canoeing or kayaking (30.0%) were also frequently reported. A smaller share of respondents (4.5%) reported engaging in other recreational activities. These patterns suggest that spring visitation supports both active and passive forms of recreation.

Table 23. Recreational characteristics of respondents in sample (N=1,806).

Variable		%	Frequency
Likely to visit a freshwater spring in the next year			
	Extremely unlikely	5.9	107
	Somewhat unlikely	8.5	154
	Neither likely not unlikely	16.2	292
	Somewhat likely	36.2	654
	Extremely likely	33.1	598
Often visit freshwater springs for recreation			
	I have never been to the springs	34.4	621
	Once a year or less	24.7	446
	1-3 times a year	12.7	230
	4-6 times a year	4.8	86
	Once a month	5.8	104
	2-3 times a month	1.5	27
	Once a week	1.6	28
	Multiple times a week	14.6	263
Recreational activities engaged in when visiting springs			
	Swimming	60.2	1,088
	Canoeing/Kayaking	30.0	542
	Hiking	31.1	561
	Wildlife viewing	52.9	955
	Photography	38.1	688
	Other	4.5	82

Respondents' perceptions of appropriate behavior at freshwater springs varied (Table 33). Actions involving direct contact with sensitive ecological features or wildlife were generally viewed as inappropriate. For example, a large majority of respondents rated stepping on vegetation in springs or spring runs (64.6% inappropriate or very inappropriate) and touching manatees (70.9% inappropriate or very inappropriate) as inappropriate behaviors.

By contrast, stepping on sand or rocks within spring runs was more widely viewed as acceptable. More than half of respondents rated stepping on sand (50.9%) and stepping on rocks (53.0%) as appropriate or very appropriate. Perceptions regarding proximity to manatees were more mixed, with respondents expressing increasing acceptance as distance increased. Walking in and around wetlands and exiting boats onto vegetated banks were generally viewed unfavorably, with pluralities rating these actions as inappropriate or neutral rather than appropriate.

Table 24. Perceived level of appropriateness related to various recreation behaviors at the springs (%)

Variable	Very inappropriate	Inappropriate	Neither	Appropriate	Very appropriate
Stepping on vegetation in springs or in springs run	29.7	34.9	21.5	10.0	3.7
Stepping on sand in springs or in springs run	6.3	11.0	31.7	41.1	9.8
Stepping on rocks in springs or in springs run	4.8	10.2	31.9	43.9	9.1
Touching manatees	46.5	24.4	16.1	9.4	3.6
Getting within 1 kayak length of manatees	30.6	31.0	19.5	14.0	4.9
Getting within 2 kayak lengths of manatees	20.0	23.1	24.4	26.7	5.6
Getting out of boats/paddle craft on vegetated bank	27.2	36.5	20.2	12.1	4.0
Walking in and around wetlands	17.9	29.0	28.0	19.8	5.4

Respondents relied on different sources of information at different stages of their spring visits (Table 34). Prior to visiting a spring, word of mouth (30.0%) and social media (24.6%) were the most commonly reported information sources, followed by online review sites (9.4%) and travel websites or blogs (9.1%). During visits, respondents most frequently reported receiving information from visitor centers (14.7%), park rangers (11.6%), and signs or posters (11.0%), alongside social media (19.2%). After visiting, social media emerged as the dominant information source (31.7%), followed by word of mouth (21.2%) and online review sites (11.6%).

These patterns suggest that informal and digital communication channels play a prominent role before and after visits, while on-site institutional sources such as visitor centers, signage, and park staff are more influential during visits.

Table 25. Sources of information for springs visitors before, during, and after their trip to the springs.

Before	%	During	%	After	%
Word of mouth	30.0	**Word of mouth**	14.8	**Word of mouth**	21.2
Social media	24.6	**Social media**	19.2	**Social media**	31.7
Other	11.0	**Other**	2.9	**Other**	4.5
Online review site	9.4	**Online review site**	5.0	**Online review site**	11.6
Travel website or blog	9.1	**Travel website or blog**	5.3	**Travel website or blog**	10.2
Visitor Center	4.2	**Visitor Center**	14.7	**Visitor Center**	5.0
Park ranger	2.3	**Park ranger**	11.6	**Park ranger**	2.7
Brochure	2.2	**Brochure**	9.9	**Brochure**	5.6
Book or magazine	2.7	**Book or magazine**	1.8	**Book or magazine**	3.4
Signs or poster	1.5	**Signs or poster**	11.0	**Signs or poster**	0
Radio or television	1.0	**Radio or television**	1.1	**Radio or television**	1.9
Local business or hotel	1.0	**Local business or hotel**	1.0	**Local business or hotel**	1.0
Tour company	1.0	**Tour company**	1.5	**Tour company**	1.2

6.2.2 DESCRIPTIVE RESULTS FOR FRAMING EXPERIMENTS

Overall, 91.4% of respondents (n = 1,649) expressed support for the proposed springs management plan, reflecting high baseline public receptivity. Support rates varied across treatment conditions, ranging from 88.0% in the economic frame group to 95.8% in the neutral ecological frame group (Table 2). The control group reported 90.0% support. The ecological + loss group (90.5%) showed nearly identical support to the control, while the ecological + gain group (92.3%) was modestly higher. These raw rates suggest that the neutral ecological message was the most effective condition and that loss framing may have attenuated the effectiveness of ecological messaging (Table 26).

Table 26. Support for Springs Management Plan by Treatment Group

Treatment group	n	Support n (%)	Oppose/neutral n (%)	Predicted Pr(Support)a
Control	371	334 (90.0%)	37 (10.0%)	0.933
Economic	351	309 (88.0%)	42 (12.0%)	0.908
Ecological (neutral)	361	346 (95.8%)	15 (4.2%)	0.971
Ecological + Loss	370	335 (90.5%)	35 (9.5%)	0.930
Ecological + Gain	352	325 (92.3%)	27 (7.7%)	0.944
Total	**1,805**	**1,649 (91.4%)**	**156 (8.6%)**	—

Note. a Predicted probabilities estimated from Model 2 with all covariates held at their sample means.

6.2.3 LOGISTIC REGRESSION RESULTS

Table 27 presents odds ratios from all three models, with standard errors in parentheses. In the base model (Model 1), only the ecological neutral frame was associated with significantly higher odds of support relative to the control group (OR = 2.56, SE = 0.81, $p < 0.001$). The economic frame (OR = 0.82), ecological + loss frame (OR = 1.06), and ecological + gain frame (OR = 1.33) did not differ significantly from control.

The full model (Model 2), which added sociodemographic, behavioral, and attitudinal covariates, yielded substantively consistent conclusions. The ecological neutral frame remained the only treatment to significantly increase support relative to control (OR = 2.39, SE = 0.78, $p < 0.01$). The economic frame (OR = 0.71), ecological + loss frame (OR = 0.95), and ecological + gain frame (OR = 1.20) remained non-significant. The attenuation in the ecological frame estimate from 2.56 to 2.39 reflects compositional adjustment for covariates, but the effect remains both statistically and substantively significant.

Among the covariates in Model 2, NEP score was the strongest predictor of support (OR = 5.27, SE = 1.26, $p < 0.001$). Education (OR = 1.32, $p < 0.001$), income (OR = 1.24, $p < 0.05$), and age (OR = 1.13, $p < 0.05$) were also significant positive predictors. Political affiliation, gender, race, visit frequency, and springs familiarity were not statistically significant. The pseudo R2 for Model 2 was 0.123, somewhat lower than the base model (0.137), reflecting the removal of the springs knowledge variable and the explanatory weight it carried.

Table 27. Logistic Regression Models Predicting Support for Springs Management Plan

	Model 1	Model 2	Model 3
Variable	**Base model**	**Full model**	**Factorial modela**
Treatment (ref = Control)			
Economic	0.82 (0.20)	0.71 (0.18)	—
Ecological (neutral)	2.56*** (0.81)	2.39** (0.78)	—
Ecological + Loss	1.06 (0.26)	0.95 (0.25)	—
Ecological + Gain	1.33 (0.35)	1.20 (0.33)	—
Message type (ref = Economic)			
Ecological message	—	—	1.56* (0.32)
Frame direction (ref = Gain)			
Loss frame	—	—	0.49*** (0.10)
Interaction (ecol x loss)	—	—	—
Sociodemographics			
Gender	—	0.71 (0.13)	0.68 (0.14)
Age	—	1.13* (0.07)	1.17* (0.08)
Education	—	1.32*** (0.10)	1.36*** (0.11)
Income	—	1.24** (0.11)	1.25** (0.12)
Political affiliation	—	0.92 (0.06)	0.95 (0.08)
Race (ref = White)			
Black or African American	—	1.04 (0.26)	0.87 (0.24)
Asian	—	0.38 (0.22)	0.37 (0.25)
Other	—	1.08 (0.47)	0.81 (0.39)
Behavioral and attitudinal			
Visit frequency	—	0.98 (0.03)	1.02 (0.04)
Springs familiarity	—	1.08 (0.12)	1.08 (0.14)
NEP score	—	5.27*** (1.26)	4.80*** (1.31)
Model fit			
N	1,805	1,805	1,434
Pseudo R2	0.137	0.123	0.132

Note. Odds ratios reported with standard errors in parentheses. aModel 3 (factorial) excludes the control group (n = 1,434). Reference categories: treatment = Control; race = White; frame direction = Gain; message type = Economic. The ecol x loss interaction term was tested but was non-significant and is omitted from the final factorial model. *** p < 0.001, ** p < 0.01, * p < 0.05.

6.2.4 FACTORIAL MODEL: MESSAGE TYPE AND FRAME DIRECTION

To isolate the independent effects of message content and loss/gain framing, Model 3 was estimated among the four experimental arms. Ecological messages significantly increased odds of support relative to economic messages (OR = 1.56, SE = 0.32, $p < 0.05$), controlling for all covariates. Loss-framed messages were associated with substantially lower odds of support compared to gain-framed messages (OR = 0.49, SE = 0.10, $p < 0.001$). The interaction between message type and frame direction was not statistically significant and was excluded from the final model. NEP score remained the dominant individual-level predictor (OR = 4.80, $p < 0.001$), with education and income also significant.

6.2.5 PREDICTED PROBABILITIES

Predicted probabilities from Model 2 are presented in Table 28 and Figure 1. For a respondent at the mean of all covariates, predicted probability of support ranged from 0.908 (economic frame) to 0.971 (ecological neutral). The predicted probability for the control group was 0.933. The ecological + loss group (0.930) fell marginally below the control group, consistent with the pattern identified in the full model — a loss-framed message produces no measurable benefit over no message at all. The ecological + gain group (0.944) and the ecological neutral group (0.971) both exceeded the control, with the neutral ecological message producing the largest predicted effect. Figure 2 illustrates the strong positive association between NEP score and predicted support probability across the observed range of the scale.

Table 28. Predicted Probabilities of Support by Treatment Group (Full Model, Covariates at Means)

Treatment group	Pr(Support)	Std. err.	95% CI lower	95% CI upper
Control	0.933	0.012	0.909	0.957
Economic	0.908	0.015	0.879	0.938
Ecological (neutral)	0.971	0.008	0.955	0.987
Ecological + Loss	0.930	0.013	0.905	0.955
Ecological + Gain	0.944	0.012	0.921	0.967

Note. Delta-method standard errors reported. Predicted probabilities estimated using margins treatment, atmeans in Stata following Model 2.

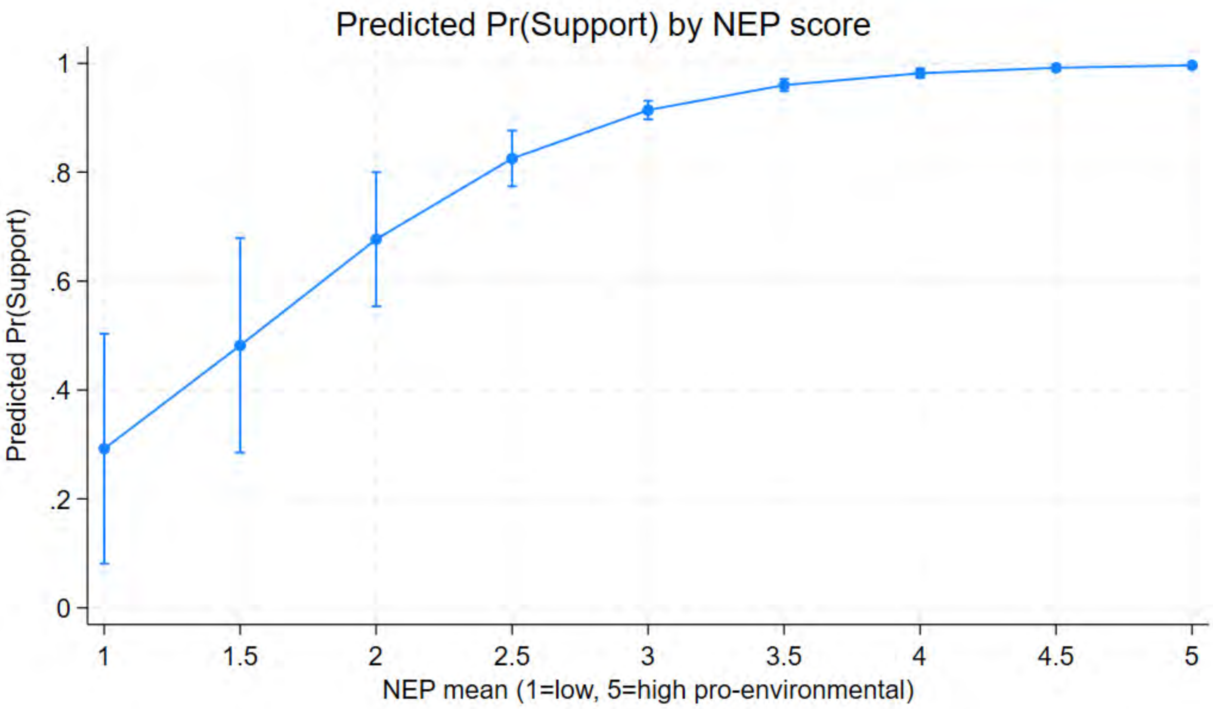

Figure 5.Predicted probability of support by framing condition. Error bars are 95% confidence intervals. Covariates held at sample means. Export from Stata: margins treatment, atmeans followed by marginsplot.

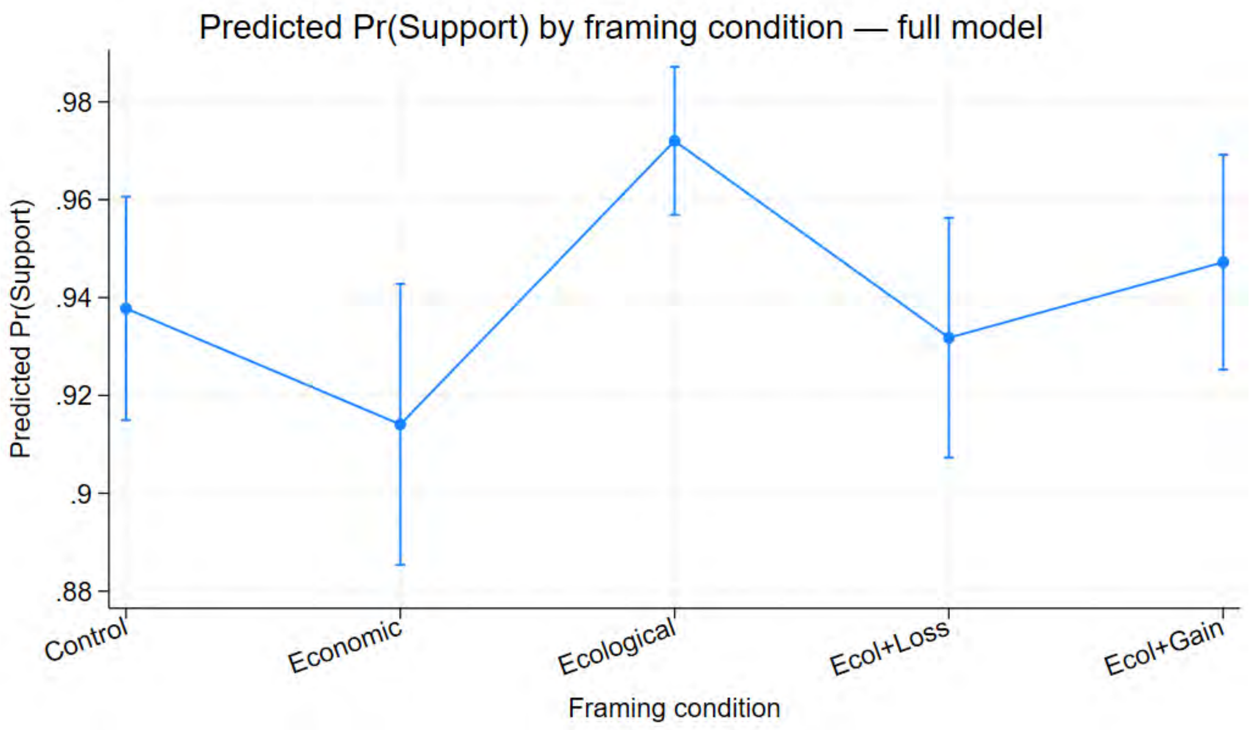

Figure 6. Predicted probability of support by NEP score. Covariates held at means. Export from Stata: margins, at(nep_mean=(1(0.5)5)) atmeans followed by marginsplot.

6.3 IMPLICATIONS

This study examined how message framing shapes public support for a Florida springs management plan, yielding four key findings with implications for both environmental communication theory and practice.

First, the neutral ecological message was the most effective framing condition, more than doubling the odds of support relative to the control group even after covariate adjustment. This finding suggests that communicating the ecological significance of springs without layering on economic appeals or loss/gain valence framing is sufficient to meaningfully increase public support. This may reflect the resonance of ecological identity and place attachment among Florida residents, many of whom have direct recreational and cultural connections to the state's spring systems. The plain ecological message appears to activate these pre-existing values without triggering the defensive responses sometimes associated with more overtly persuasive messaging.

Second, loss framing consistently reduced support relative to gain framing, with loss-framed respondents showing odds of support roughly half those of gain-framed respondents. The predicted probability for the ecological + loss group (0.930) fell marginally below the control group (0.933), suggesting that a loss-framed ecological message provides no measurable benefit over receiving no message at all. This pattern is consistent with psychological reactance theory, which predicts that threatening or coercive messaging can motivate opposition rather than compliance. For practitioners, this finding is a clear caution against deploying threat-based (loss-framed) conservation messaging in this context.

Third, the non-significance of the economic frame is noteworthy. Economic arguments are commonly used in conservation advocacy, but they did not outperform the control condition in this context. Economic framing may be perceived as less personally relevant or motivating than ecological framing among Florida residents, for whom springs carry strong aesthetic, recreational, and cultural meaning that economic discourse may fail to activate.

Fourth, New Ecological Paradigm (NEP) score was by far the strongest individual-level predictor of support (OR = 5.27), substantially outpacing all demographic predictors and the treatment effects themselves. This suggests that environmental worldview is a powerful baseline orientation shaping receptivity to springs management regardless of how the issue is framed. Respondents with stronger pro-environmental worldviews are dramatically more likely to support the proposed springs management plan across all conditions. Future research might explore whether framing effects are moderated by NEP score — examining whether individuals with weaker pro-environmental orientations are particularly responsive to certain message types could identify the most persuadable audiences and optimal message strategies for reaching them.

Several limitations should be noted. The high overall support rate (91.4%) creates a ceiling effect that may have reduced statistical power to detect treatment differences, particularly for the gain framing conditions. The online panel sample may not be fully representative of Florida's population. Additionally, stated survey support may not translate directly to behavioral support for regulatory action.

7. CONCLUSIONS

This report has provided an integrated economic and social assessment of fifteen publicly managed spring sites in the Lower Suwannee and Santa Fe River basins, combining visitation records, on-site expenditure surveys, travel cost modeling, ecosystem service valuation, and a statewide framing experiment. Taken together, the five analyses yield a coherent and mutually reinforcing picture of the value that Florida's springs provide to the region, and of the conditions under which that value can be sustained.

First, the springs remain a regional asset of statewide significance. Across the twelve-year study period, the fifteen public sites averaged approximately 1.38 million visitor-days per year, and approximately 81 percent of visitors came from outside the immediate local area. Visitor spending at these sites supports an estimated 427 jobs, $11.1 million in labor income, $22.1 million in regional GDP, and $7.9 million in annual tax revenues, with an additional $7.8 to $10.2 million per year in non-market recreational benefit to visitors themselves. These figures exclude four substantial privately owned springs and are therefore conservative lower bounds on the true regional contribution of spring-based recreation.

Second, the largest component of total value lies off-site rather than at the spring vent. Benefit transfer and GIS land cover analysis indicate that the ecosystem services provided by spring-connected landscapes—nutrient removal, carbon sequestration, flood attenuation, and water clarity—exceed $175 million per year across the five Spring Protection Areas analyzed, with more than $37.5 million per year within five-mile buffers around individual springs. The implication is that wetland and forest conversion within recharge zones and protection areas represents foregone value at a scale comparable to, or larger than, the full on-site recreational economy. For a county environmental management agency, this finding points to land use planning, conservation easements, and recharge-area protection as primary levers, with direct consequences for downstream spring condition.

Third, economic and ecological values are not substitutes but complements, and the two are tied to the same underlying resource. Spring condition determines visitation, visitation determines expenditures, and expenditures sustain the jobs and tax revenues that local economies depend upon. Stated-preference responses indicate that visitors would take roughly 39 additional trips per year if water quality improved and 44 additional trips if crowding were reduced, suggesting meaningful latent demand that is currently constrained by environmental and congestion pressures. Degradation, in this framework, is not a separate ecological problem; it is the mechanism through which the economic values documented in this report erode.

Fourth, public support for spring protection is broad but communication strategy matters. Baseline support for the management plan tested in the statewide survey was 91 percent, and ecological framing was the only experimental condition that significantly increased support relative to the control (predicted probability of 0.97 versus 0.93). Economic framing performed marginally worse than no message at all, and loss-framed messaging consistently underperformed gain-framed messaging. The practical implication for outreach materials, public meetings, and agency communications is clear: lead with the ecological case, frame protection in terms of what is preserved rather than what is lost, and treat economic arguments as complementary background rather than as the primary appeal.

Taken together, these findings point to a concrete set of priorities for county-level environmental management. Landscape-scale conservation in recharge zones and Spring Protection Areas should be treated as the single most consequential lever for sustaining spring value, because that is where the largest share of ecosystem service value resides. On-site investment remains worthwhile, particularly at high-use sites where water quality and crowding directly shape both visitor welfare and visitation levels, but it will not substitute for upstream land use decisions. Investment in consistent visitor counting at free-entry county parks would meaningfully improve the precision of future assessments and reduce the current dependence of regional estimates on a single reference site. And public outreach should emphasize ecological integrity, gain framing, and the identities and attachments that Florida residents already bring to the state’s spring systems.

Several limitations qualify these conclusions and suggest priorities for future work. The exclusion of privately owned springs and of Suwannee County Boating Use Attraction-related activity means that regional totals are conservative, and periodic outreach to private operators or the use of alternative visitation proxies would strengthen future assessments. The travel cost sample of non-local visitors (N = 73) was adequate for estimation but produced wide confidence intervals; repeat surveys with larger samples would tighten these estimates. Ecosystem service values rely on benefit transfer and should be refined with locally calibrated estimates where feasible, particularly for carbon and flood attenuation. Finally, the high ceiling on stated support for spring protection masks variation that may be important for targeting outreach, and follow-up work exploring how framing effects vary across audiences with differing environmental worldviews would help identify where communication investments are most productive. None of these limitations change the central conclusion of this report: Florida’s springs generate substantial, measurable, and sustained economic, ecological, and social value, and protecting that value is an investment in the long-term public interest of the counties in which these springs reside.

APPENDIX A: LOCATION OF ORIGIN FOR INTERCEPT SURVEY RESPONDENTS

States Represented:

Alaska	New York
Alabama	Ohio
Georgia	South Carolina
Massachusetts	Virginia
Minnesota	Washington
Mississippi	Wisconsin
North Carolina	

Florida Cities Represented:

Alachua	Mayo
Archer	Melbourne
Bell	Miami
Boynton Beach	Micanopy
Brandon	Milton
Bronson	Morriston
Brooksville	Mulberry????
Chiefland	New Port Richey
Chuluota	Newberry
Citra	O'Brien
Clermont	Ocala
Crystal River	Old Town
Daytona Beach	Orlando
Dunedin	Palm Harbor
Edgewater	Parkland
Fanning Springs	Perry
Fleming Island	Rockledge
Fort White	San Antonio
Ft. Lauderdale	Santa Rosa Beach
Gainesville	Sarasota
Georgetown	Silver Springs
Gotha	Spring Hill
Hawthorne	St. Augustine
High Springs	Starke
Homosassa	Suwannee
Hudson	Tallahassee
Inglis	Tampa
Inverness	Trenton
Jacksonville	Waldo
Jasper	Weeki Wachee
Kissimmee	Williston
Labelle	Winter Haven
Lake City	
Lakeland	
Lee	
Leesburg	
Live Oak	

Country Represented:

Poland

APPENDIX B: SURVEY INSTRUMENTS FOR INTERCEPT SURVEY (TRAVEL COST MODEL)

1. What city and state do you currently live in?

____

2. Is this your first time at this spring?

- ○ Yes
- ○ No

3. **If no,** approximately how many day trips have you taken to this spring in the last 12 months?

____

4. Is visiting this spring part of a longer trip where you spend more than one night away from your home?

- ○ Yes (list how many days): _____
- ○ No

5. Approximately how far did you drive from your home (or hotel/vacation rental) to get to this spring?

- ○ One-way distance (miles): _______
- ○ One-way travel time (hours/minutes): _______

6. Is visiting the springs a primary purpose of this trip?

- ○ Yes
- ○ No

6a. If **no**, what other places are you visiting? ____

7. How many people are in your group, including yourself? ________

8. What is your annual household income?

____

9. What is your current employment status?

- ○ Full-time
- ○ Part-time
- ○ Student
- ○ Other

10. What year were you born? ___________

11. What is your gender?
- ○ Male
- ○ Female
- ○ Non-binary

12. What is the highest level of education you have obtained?
- ○ High School or GED
- ○ Some College, No Degree
- ○ Associate’s Degree/ Technical College
- ○ Bachelor's Degree
- ○ Master's Degree
- ○ Doctoral or Professional Degree

13. On a scale of 1-5, how would you rate the following in this area compared to what you expected?

	Much Lower	Lower	About As Expected	Better	Much Better
Facilities	○	○	○	○	○
Water Clarity	○	○	○	○	○
Crowding (e.g., number of visitors)	○	○	○	○	○

14. If the **facilities** at the spring improved, how many more trips per year would you take to this spring?

# of trips = _________

15. If the **water quality** of the spring improved, how many more trips per year would you take to this spring? # of trips = _________

16. If the **crowding** (e.g., number of visitors) was reduced, how many more trips per year would you take to this spring? # of trips = ______________

17. Please mark all the springs that you have visited in the last 12 months: (Check all that apply)

- ○ Fanning Springs State Park
- ○ Hart Springs State Park
- ○ Ichetucknee Springs State Park
- ○ Lafayette Blue Springs State Park
- ○ Little River Spring County Park
- ○ Manatee Springs State Park
- ○ Poe Springs County Park
- ○ Rum Island Spring County Park
- ○ Troy Spring State Park
- ○ Wes Skiles Peacock Springs State Park
- ○ Gilchrist Blue Springs State Park
- ○ Blue Grotto Spring
- ○ Devil's Den Spring
- ○ Ginnie Springs
- ○ Hornsby Springs
- ○ Other: ______________________________

18. What is your primary recreational activity you are participating in at this spring?

- ○ Swimming
- ○ Tubing
- ○ Kayaking/Canoeing/Paddleboarding
- ○ Wildlife viewing
- ○ Hiking or Walking
- ○ Picnicking
- ○ Diving
- ○ Snorkeling
- ○ Other: ____________________

19. How many times a year do you go to a natural area for any of outdoor recreation activity?

- ○ None
- ○ 1-10 times a year
- ○ 11-20 times a year
- ○ 21-30 times a year
- ○ More than 31 times a year

20. Please indicate how important each experience is to you when you are recreating at this spring

(1 = Not Important At All to 5 = Very Important)

	1	2	3	4	5
To enjoy the scenery					
To relax physically					
To do something with my family					
To get exercise					
To experience nature					
To be on my own					
To use my own equipment					
To learn about natural history of the area					
To be away from people					
To have thrills and excitement					
To learn more about nature					
To meet new people					
To test my skills and abilities					
To be with members of my group					
To be close to nature					
To be with people who enjoy the same things I do					
To experience new and different things					
To experience solitude					
To feel healthier					

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For further questions, please contact the Principal Investigator, Dr. Kotryna Klizentyte, at kklizentyte@ufl.edu.

Survey Location: ___________________________________

Survey Date: ____

Surveyor Initials: ___________________________________

Expenditures:

How much did you spend on the following **just to be at this spring?**

Auto/Truck or RV fuel	**$**	○ **None**
Auto/Truck or RV rental	**$**	○ **None**
Airfare	**$**	○ **None**
Lodging	**$**	○ **None**
Groceries	**$**	○ **None**
Restaurants/Bars	**$**	○ **None**
Parking or Site Access Fees	**$**	○ **None**
Gifts or Souvenirs	**$**	○ **None**
Tube or Kayak Rental	**$**	○ **None**

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For further questions, please contact the Principal Investigator, Dr. Kotryna Klizentyte, at kklizentyte@ufl.edu.

Survey Location: ________________________________

Survey Date: ____________________________________

Surveyor Initials: ________________________________

APPENDIX D: TRAVEL COST MODEL SPECIFICS

Recreational benefits associated with spring visitation were estimated using a travel cost demand model based on data collected through an on-site intercept survey of spring visitors. To ensure a representative sample of springs visitors was collected, we employed a random stratified sampling method based on spring, day of the week, and time of day. We employed weights on springs based on their visitation rates, so the springs that had higher visitation rates were more likely to be sampled. Additionally, we weighted weekends (Fridays, Saturdays, and Sundays) more than weekdays to reflect higher visitation rates.

The survey instrument collected information on:

- Number of trips to the spring taken in the past 12 months
- Travel distance and travel time
- Group size
- Socio-demographic characteristics (age, income, gender, education)
- Visitor perceptions of facilities, water quality, and crowding
- Stated changes to number of trips to springs under hypothetical improvements to site conditions
- Recreation activity motivations
- Springs visited in last 12 months

The dependent variable in the recreation demand model was the annual number of trips taken to the select spring, which is a non-negative count variable. Consistent with the Travel Cost Model (TCM) framework, recreation demand is commonly explained by variables such as income, travel expenses, and travel time (Loomis, 2011; Whitehead, 2006). In addition to these core factors, the present study includes demographic attributes—such as gender, educational attainment, and race—as well as variables capturing site-specific preferences and recreational activities, to more comprehensively examine determinants of trip frequency (Parsons, 2003; Martinez-Espineira et al., 2008; Klizentyte et al., 2023; Lothrop et al., 2014). Travel cost serves as a central explanatory variable in TCM and reflects both out-of-pocket transportation expenses and the opportunity cost of time spent traveling. Rather than relying on self-reported travel expenditures, this study derives implicit travel costs using information on travel distance and time. Adapting the approach proposed by Hwang et al. (2021), travel costs are calculated as:

$$tc_i = \left(\frac{D_i}{mpg_i}\right) * P_g + \frac{1}{3} * \left(\frac{I_i}{2{,}080}\right) * \left(\frac{D_i}{40}\right)$$

The first component of this expression captures fuel costs by dividing round-trip travel distance (D_i) by vehicle fuel efficiency (mpg_i) and multiplying by the prevailing gasoline price (P_g). This formulation explicitly accounts for differences in vehicle efficiency, allowing travel costs to vary across individuals depending on vehicle type—a consideration emphasized in prior TCM research. The second component estimates the opportunity cost of travel time, assuming it equals one-third of the individual's hourly wage, calculated by dividing annual income (I_i) by 2,080 work hours. Travel time is approximated by assuming an average travel speed of 40 miles per hour, consistent with assumptions used in previous studies (Hwang et al., 2021; Landry et al., 2020). To address potential heterogeneity in travel behavior, the travel cost model is estimated for both the full sample (Florida and non-Florida residents) and two restricted models of local and non-local Floridan residents, separately.

Because trip data exhibited over-dispersion, a negative binomial regression model was used to estimate recreation demand as a function of travel cost and visitor characteristics. The following represents the negative binomial regression model specification:

$$\lambda = \exp\,(\beta_0 + \beta_1 travelcost_i + \beta_2 age + \beta_3 visiting_{primarypurpose} + \beta_4 gender \\ + \beta_5 education + \beta_6 income + \beta_7 groupsize)$$

where λ represents the expected latent demand for recreational site visits, β_0 is the intercept term and β_1 through β_7 are the coefficients for each independent variable. The inclusion of these variables allows the model to capture both the economic and behavioral factors driving recreation demand. Table X shows a list and description of variables included in the model.

Table 29. Variables included in the travel cost model and intercept survey.

Variable	Notation	Description
Total Travel Cost	Total Travel Cost	The total travel cost associated with visiting the spring, including the opportunity cost of time
Visit to Spring Part of a Longer Trip	LongerTrip	Dummy variable =1 if trip to springs was part of a longer trip to area
Visit to Spring Primary Purpose of trip	PrimaryPurpose	Dummy variable =1 if visit to springs was the sole purpose of the trip
Recreation Motivation: **Learning, Exploring. Connecting in Nature**	LearningExploringConnect	Factor analysis weight for recreation motivation group related to learning, exploring, and connecting in nature (continuous variable)
Recreation Motivation: **Be in Solitude and Use Equipment**	SolitudeEquipment	Factor analysis weight for recreation motivation group related to being in solitude and using equipment in area (continuous variable)
Recreation Motivation: **Be In Nature and Relaxation**	BeInNatureRelax	Factor analysis weight for recreation motivation group related to being in nature and relaxing in nature (continuous variable)
Recreation Motivation: **Exercise and Improve health**	ExerciseHealth	Factor analysis weight for recreation motivation group related to exercising and improving physical/mental health in nature (continuous variable)
Recreation Motivation: **Be with family**	Family	Factor analysis weight for recreation motivation group related to being with family members in nature (continuous variable)
Female	Female	A dummy variable indicating the respondent's gender (1=female; 0= male)
Education	Edu_lowercollege	Education level dummy variables representing whether the visitor has a high school or Bachelor's degree
Household income	HHI	Household income of respondent (continuous variable)
Age	Age	The visitors age (continuous)
Employment status	Fulltime	Dummy variables =1 indicating current employment status of respondent
	Parttime	
	Student	
Number of people in group	People in groups	The total group size the survey respondent is with at the spring
Facilities at Spring	Facilities	Respondent perception of facilities at spring (Likert-type)
Water Quality at Spring	Water quality	Respondent perception of water quality at spring (Likert-type)
Crowding at Spring	crowding	Respondent perception of crowding at spring (Likert-type)

APPENDIX E: ECOSYSTEM SERVICE VALUATION CENTRAL/HIGH ESTIMATES AND LIMITATIONS

E.1 ECOSYSTEM SERVICES INCLUDED

The ecosystem services evaluated include: (1) water quality improvement, via nutrient removal by freshwater wetlands and riparian buffers, (2) carbon sequestration, from forested and wetland ecosystems (soil and biomass), (3) flood attenuation and water regulation, via hydrological functions of wetlands and (4) water clarity and aesthetic support, represented as a proxy for open water values based on willingness-to-pay studies in Florida springs. These services were selected based on their ecological significance, relevance to springshed function, and availability of transferable economic valuation data (Batchvarova and Koulov, 2025; Howard et al., 2023).

The definitions of each ecosystem service are listed below:

Ecosystem Service	Definition
Water quality	The ability of ecosystems (e.g., wetlands, forests, riparian buffers) to reduce pollutants and improve water conditions by filtering, retaining, and transforming nutrients (nitrogen and phosphorus), sediments, and other contaminants before they reach groundwater, springs, rivers, or estuaries.
Carbon sequestration	The long-term capture and storage of carbon dioxide (CO_2) from the atmosphere in vegetation (trees, plants) and soils, which helps mitigate climate change by reducing net greenhouse gas concentrations.
Flood attenuation and water regulation	The capacity of natural landscapes to store, slow, and regulate the movement of water across the land through infiltration, groundwater recharge, and surface water retention—reducing flood peaks, supporting baseflows, and stabilizing hydrologic conditions over time.
Water clarity and aesthetics	The visual and recreational benefits provided by clean, clear water and healthy aquatic habitats, including improved scenic quality, visitor enjoyment, and perceived environmental health, which contribute to recreation, tourism, and quality of life

E.2 SPATIAL DATA

Land cover and land use data were derived from publicly available GIS shapefiles and grouped into functional ecosystem categories based on the Florida Land Use, Cover and Forms

Classification System (FLUCCS) from the Florida Department of Environmental Protection (FDEP). FLUCCS is a standardized classification framework used statewide to categorize land cover types based on dominant vegetation, land use zoning/function, and surface water features.

For this analysis, FLUCCS codes were used to group mapped land cover features to estimate ecosystem service categories listed in 5.1.1., and consisted of individual land cover classes that aggregated into four categories: forested wetlands/swamps, marsh/wet prairie/aquatic vegetation, upland forest, and open water/springs. The FLUCCS subtypes that were included in the categories are described and listed in Table 25.

Table 30. Functional system category with ecosystem subtypes and descriptions.

Functional Ecosystem Category	Primary FLUCCS Codes Used	Ecosystem Subtypes Included	Description
Forested wetlands/swamps	6000 series	Bay swamps Gum swamps Titi swamps Stream and lake swamps Mixed wetland hardwoods Cypress Hydric pine flatwoods Wetland forested mixed	Forested wetlands characterized by hydrophytic woody vegetation on hydric soils, including cypress, bay/gum/titi swamps, stream and lake swamps, mixed wetland hardwoods, and other wetland forested mixed communities.
Marsh/wet prairie/aquatic vegetation	6000 series	Freshwater marshes Wet prairies Emergent aquatic vegetation Mixed scrub-shrub wetland Non-vegetated wetlands Intermittent ponds	Non-forested freshwater wetlands dominated by herbaceous or emergent vegetation
Upland forest	4000 series	Sand pine Upland hardwood forests Xeric oak Live oak Cabbage palm Hardwood Coniferous-Mixed Coniferous plantations Forest regeneration areas	Upland forests are forested land cover types occurring on non-hydric, well-drained soils, where vegetation is dominated by hardwood and/or coniferous tree communities.
Open water/springs	5000 series	Streams and waterways Channelized waterway Lakes Reservoirs Major springs Slough waters	Open water features are surface water land cover types characterized by standing or flowing water

In order to understand the ecosystem service values connected to the springs in the study area, I used two different zonal areas: (1) a 5-mile buffer around each spring, and (2) using existing Spring Protection Areas designated by FDEP. Here is an explanation of each approach:

(1) **5-mile buffer:** In ArcGIS Pro, a spatial join was performed with the FLUCCS shapefile and spring location data from FDEP. Next, I created a 5-mile buffer zone using the *buffer* tool. A 5-mile buffer also serves as a pragmatic, standardized approximation when a fully delineated springshed or PFA boundary is unavailable or inconsistent across sites. This distance is intended to capture a substantial portion of the near-field contributing landscape most likely to affect spring condition (particularly in karst settings where vulnerability can be high), while avoiding the inclusion of distant areas where relationships to spring condition may be more uncertain. However, this method may create ‘double-counting’ where spring areas overlap and not provide the best estimates. Following the creation of the buffers, the *clipping* tool was used to overlay ecosystem types within the 5-mile buffer (Figure 2). This was used to estimate the exact acreage of ecosystem types to then calculate ecosystem service values.

(2) **Spring Protection Areas:** Florida DEP’s Springs Protection Areas (SPAs), produced by the Florida Geological Survey, map the broader areas of land contributing flow to Florida springs. They were created as a published resource for land-use decision-makers working to protect both the quantity and quality of water discharging from springs. These boundaries delineate spring contributing areas and are appropriate spatial targets for ecosystem service valuation and land management at the landscape scale. SPAs are distinct from FDEP’s Priority Focus Areas (PFAs), which are narrower regulatory boundaries delineated only for impaired Outstanding Florida Springs under the Florida Springs and Aquifer Protection Act. This study uses the SPA layer, not PFAs. There are five distinct SPAs in the study area: (1) Troy Peacock LafayetteBlue Falmouth, (2) Ichetucknee, (3) Devil’s Ear, (4) Fanning Manatee, and (5) Columbia Hornsby Treehouse (Figures 3 and 4). I used the *clipping tool* in ArcGIS to show the functional FLUCCS ecosystem types within each spring protection area.

After creating the layers for both of these zones, I then summarized the acreage totals per ecosystem type. Table 26 shows the types and amounts of land surrounding each spring within a 5-mile radius, which represents the nearby landscape most likely to influence spring conditions. For all springs, upland forests make up the largest portion of surrounding land, followed by forested wetlands and swamps. Smaller areas consist of open water and spring features and marshes or wet prairies. While forests are common around all springs, the amount of wetland and marsh land varies noticeably from spring to spring. Springs such as Manatee, Little River, Troy, and Suwannee Blue are surrounded by relatively larger wetland areas.

Table 31. Ecosystem types in acres for each spring within the 5-mile buffer method.

Spring Name	Upland forest	Open water/springs	Forested wetlands/swamps	Marsh/wet prairie/aquatic vegetation
Coffee Spring	25,875	308	1,647	136
Fanning Spring	20,624	989	4,089	326
Gilchrist Blue Spring	23,464	274	3,263	295
Hornsby Spring	21,392	371	3,055	35
Ichetucknee Springs	25,606	310	916	56
Lafayette Blue Spring	21,326	570	2,466	195
Little River Spring	21,705	746	5,829	2,766
Manatee Spring	28,339	992	8,506	3,071
Peacock State Park	20,442	438	1,783	60
Poe Spring	22,096	272	2,632	65
Poe Woods Spring	22,313	278	2,561	58
Rum Island Spring	23,201	287	3,222	251
Suwannee Blue Spring	26,063	491	5,707	651
Troy Spring	21,198	746	4,945	2,136
TOTAL	323,644	7,072	50,621	10,101

Table 27 summarizes the types of land found within officially designated Spring Protection Areas, which cover broader regions identified for spring protection and management. As with the 5-mile buffers, upland forests dominate these areas across all spring systems, indicating that most protected spring landscapes are largely forested. Forested wetlands and marshes also make up a substantial share of land in several protection areas, especially in the Troy–Peacock, Fanning–Manatee, and Devil’s Ear systems. Differences in the amount of open water and spring features reflect variation in river networks and spring density among systems.

Table 32. Ecosystem type acreages for Springs Protection Areas.

Ecosystem Type	Troy Peacock LafayetteBlue Falmouth	Ichetucknee	Devil's Ear	Fanning Manatee	Columbia Hornsby Treehouse
Upland forest	684,765	140,235	61,262	65,290	10,296
Open water/springs	100,534	34,618	5,707	4,664	1,347
Forested wetlands/swamps	91,243	39,273	10,515	6,157	1,751
Marsh/wet prairie/aquatic vegetation	81,073	24,902	1,024	8,416	1,236

E.3 BENEFIT TRANSFER METHODOLOGY

Ecosystem service values were estimated using a benefit transfer methodology, which applies economic values derived from previously published studies and policy-relevant valuation tools to the current study context. This approach is widely accepted for environmental policy analysis, land-use planning, and resource management when primary valuation is infeasible due to time, budget, or data constraints, and when the objective is to generate screening-level or comparative estimates rather than site-specific welfare measures (Boyd & Krupnick, 2009; U.S. EPA, 2016).

The benefit transfer framework used in this study applies per-acre-per-year monetary values to mapped ecosystem acreage within defined spatial units (5-mile buffers and Spring Protection Areas). Values were drawn from peer-reviewed literature, federal guidance documents, and regionally relevant studies focused on Florida or the southeastern United States. Where necessary, biophysical ecosystem service rates were combined with economic unit values to derive monetary estimates. All values are reported in 2023 U.S. dollars.

Per-acre values were developed separately for each ecosystem service and ecosystem type. Values were specified as low, central, and high estimates to reflect uncertainty in ecological performance, valuation assumptions, and spatial heterogeneity (Table 28).

E.4.1 WATER QUALITY SERVICES (NUTRIENT REMOVAL AND FILTERING)

Water quality benefits were estimated for freshwater wetlands and riparian forest buffers, reflecting their documented capacity to reduce nutrient loads through sediment retention, plant uptake, and denitrification processes. Per-acre nutrient removal values for wetlands were derived by combining reported nutrient reduction efficiencies from southeastern U.S. wetland systems with benchmark nutrient control costs expressed in dollars per unit of nutrient removed. These benchmarks are based on the costs of achieving equivalent nutrient reductions through engineered alternatives such as constructed treatment wetlands, stormwater best management practices, and wastewater treatment upgrades (Dunne et al., 2015; U.S. EPA, 2015; Isik et al., 2023).

For riparian forest buffers, nutrient filtering values were informed by empirical studies linking buffer vegetation and width to nitrate and sediment reduction, monetized using comparable nutrient reduction cost benchmarks (King et al., 2016; U.S. EPA, 2015). This avoided-cost approach reflects the replacement value of natural nutrient retention services provided by riparian ecosystems.

E.4.2 CARBON SEQUESTRATION (SOIL AND BIOMASS)

Carbon sequestration values were estimated for forested wetlands, riparian forests, and upland forests, based on published estimates of annual carbon uptake in both biomass and soils. Wetland carbon values reflect high rates of soil carbon accumulation under saturated conditions, while forest values reflect biomass growth and soil carbon dynamics typical of southeastern forest systems (Villa et al., 2015; Smith et al., 2007; Texas Coastal Exchange, 2020).

Biophysical carbon sequestration rates, reported in metric tons of carbon or CO_2e per acre per year, were monetized using the Social Cost of Greenhouse Gases (SC-GHG) published by the U.S. Environmental Protection Agency (EPA, 2023). Low, central, and high values correspond to alternative discount rate assumptions and represent uncertainty in long-term marginal climate damages.

E.4.3 FLOOD ATTENUATION AND WATER REGULATION

Flood attenuation and water regulation benefits were estimated for freshwater wetlands, reflecting their capacity to store floodwaters, reduce peak flows, and mitigate downstream flood damages. Per-acre values were derived from empirical studies that link wetland extent to reductions in flood insurance claims and FEMA-reported flood damages across southeastern U.S. watersheds. These studies estimate annualized avoided flood damages, which were converted to per-acre values suitable for benefit transfer (Taylor & Ortenzi, 2021; Taylor & Ortenzi, 2022; FEMA, 2022).

This avoided-cost framework is commonly used in ecosystem service valuation when regulating services reduce economic damages that would otherwise occur under alternative land-use scenarios.

E.4.4 WATER CLARITY AND AESTHETIC SERVICES (PROXY VALUES)

Water clarity and aesthetic benefits were estimated for open water and spring features using proxy per-acre values derived from willingness-to-pay studies conducted in Florida springsheds. These studies estimate economic benefits associated with improved water clarity, reduced turbidity, and enhanced recreational and scenic quality resulting from spring restoration or water quality improvements (Wu et al., 2018; UF/IFAS EDIS FE959).

Because direct per-acre aesthetic values for open water features are rarely reported, these estimates are intended as conservative proxies rather than precise measures of recreational demand. Values were applied uniformly across open water acreage to support comparative analysis across spatial units.

Table 33. FLUC ecosystem group, ecosystem service, assumptions, and sources to estimate per acre values.

FLUC ecosystem group	Ecosystem service	Unit	Low	Central	High	Basis / assumptions	Key sources
Freshwater wetlands (FLUC 600s)	Water quality (nutrient removal)	$/acre/year	300	850	1500	Derived using (a) SE U.S. wetland nutrient removal efficiencies and (b) nutrient reduction cost benchmarks (e.g., $/lb N or $/kg P removed; constructed treatment wetland O&M and removal costs).	Isik et al. 2023; Dunne et al. 2015; U.S. EPA 2015
Freshwater wetlands (FLUC 600s)	Carbon sequestration (soil + biomass)	$/acre/year	120	250	450	Carbon sequestration rates reported for Florida wetlands converted to CO2e and valued using SCC (low/central/high SCC assumptions).	Villa et al. 2015; U.S. EPA 2023 (SC-GHG)
Freshwater wetlands (FLUC 600s)	Flood attenuation & water regulation	$/acre/year	200	600	1200	Based on empirical estimates linking wetland area to reduced flood insurance claims / flood damages (annualized benefit), scaled to per-acre terms.	Taylor & Ortenzi 2021 (RFF); Taylor & Ortenzi 2022 (AER); FEMA 2022
Riparian forest buffers (typ. FLUC 411/412)	Water quality (nutrient filtering)	$/acre/year	250	700	1400	Derived from buffer nitrate reduction/denitrification ranges combined with nutrient reduction cost benchmarks ($/lb N removed).	King et al. 2016; U.S. EPA 2015
Riparian forest buffers (typ. FLUC 411/412)	Carbon sequestration	$/acre/year	90	180	350	Bottomland/riparian forest CO2 sequestration rates (SE U.S. examples) valued using SCC (range).	Texas Coastal Exchange 2020; U.S. EPA 2023 (SC-GHG)
Upland forest (pine/hardwood; FLUC 400s)	Carbon sequestration	$/acre/year	40	90	180	Forest carbon accumulation rates (U.S., with relevance to fast-growing Southeast) converted to CO2e and valued using SCC.	USFS 2007 (Smith et al.); U.S. EPA 2023 (SC-GHG)
Open water / springs (FLUC 510–520)	Water quality & clarity support (proxy)	$/acre/year	150	400	900	Proxy values anchored to Florida springs recreation and restoration willingness-to-pay evidence; intended as a conservative placeholder where per-acre clarity values are needed.	Wu et al. 2018; UF/IFAS EDIS FE959

Notes on Valuation Sources: (1) Nutrient removal values were developed using wetland and riparian nutrient reduction rates, combined with Florida- and EPA-derived benchmarks for nutrient control costs in dollars per pound of nitrogen or phosphorus reduced (e.g., constructed treatment wetlands, stormwater BMPs), (2) Carbon sequestration values were based on published estimates of annual carbon uptake rates (in tons CO_2e per acre), with monetary values applied using the Social Cost of Carbon (SC-GHG) from the U.S. EPA (2023). The SCC used ranged from $56 (low) to $190 (high) per metric ton CO_2e, reflecting varying discount rates, (3) Flood attenuation values were derived from studies linking wetland area to reductions in downstream flood damage and FEMA-insured losses. Taylor & Ortenzi (2021, 2022) developed empirical models linking wetland coverage to annualized avoided costs in Southeastern U.S. watersheds, and (4) Open water values represent a proxy estimate for aesthetic and recreational services linked to water clarity. These are based on willingness-to-pay studies conducted in Florida springsheds, particularly those estimating economic benefits from spring restoration or reduced turbidity

Table 34. Ecosystem service value estimates based on ecosystem type.

	Freshwater wetlands	Riparian forest buffer	Upland forest	Open water/springs
WQ Nutrient Removal (L)	300			
WQ Nutrient Removal (C)	850			
WQ Nutrient Removal (H)	1500			
Wetland Carbon (L)	120			
Wetland Carbon (C)	250			
Wetland Carbon (H)	450			
Flood Attenuation (L)	200			
Flood Attenuation (C)	600			
Flood Attenuation (H)	1200			
WQ Nutrient Filtering (L)		250		
WQ Nutrient Filtering (C)		700		
WQ Nutrient Filtering (H)		1400		
Riparian Carbon (L)		90	40	
Riparian Carbon (C)		180	90	
Riparian Carbon (H)		350	180	
Upland Carbon (L)		90	40	
Upland Carbon (C)		180	90	
Upland Carbon (H)		350	180	
Springs Clarity Proxy (L)				150
Springs Clarity Proxy (C)				400
Springs Clarity Proxy (H)				900

Table 35. Ecosystem type acreages for each individual spring.

Spring Name	Upland forest	Open water/springs	Forested wetlands/swamps	Marsh/wet prairie/aquatic vegetation
Coffee Spring	25,875	308	1,647	136
Fanning Spring	20,624	989	4,089	326
Gilchrist Blue Spring	23,464	274	3,263	295
Hornsby Spring	21,392	371	3,055	35
Ichetucknee Springs	25,606	310	916	56
Lafayette Blue Spring	21,326	570	2,466	195
Little River Spring	21,705	746	5,829	2,766
Manatee Spring	28,339	992	8,506	3,071
Peacock State Park	20,442	438	1,783	60
Poe Spring	22,096	272	2,632	65
Poe Woods Spring	22,313	278	2,561	58
Rum Island Spring	23,201	287	3,222	251
Suwannee Blue Spring	26,063	491	5,707	651
Troy Spring	21,198	746	4,945	2,136
TOTAL	323,644	7,072	50,621	10,101

Table 36. Ecosystem service values of individual springs with 5-mile buffers (central estimates).

	Water quality (nutrient removal/filtering)	Carbon sequestration (soil + biomass)	Flood attenuation and water regulation	Water clarity and aesthetics
Coffee Spring	$1,268,500	$2,659,210	$81,600	$123,200
Fanning Spring	$3,139,400	$2,673,680	$195,600	$395,600
Gilchrist Blue Spring	$2,534,850	$2,772,850	$177,000	$109,600
Hornsby Spring	$2,168,250	$2,483,930	$21,000	$42,000
Ichetucknee Springs	$688,800	$2,483,420	$33,600	$124,000
Lafayette Blue Spring	$1,891,950	$2,411,970	$117,000	$228,000
Little River Spring	$6,431,400	$3,694,170	$1,659,000	$298,400
Manatee Spring	$8,564,550	$4,849,340	$1,842,600	$396,800
Peacock State Park	$1,299,100	$2,175,720	$36,000	$175,200
Poe Spring	$1,897,650	$2,478,650	$39,000	$108,800
Poe Woods Spring	$1,842,000	$2,483,650	$34,800	$111,200
Rum Island Spring	$2,468,750	$2,730,800	$150,600	$114,800
Suwannee Blue Spring	$4,548,250	$3,535,680	$390,600	$196,400
Troy Spring	$5,277,100	$3,331,920	$1,281,600	$298,400
TOTAL	$44,020,550	$40,764,990	$6,060,000	$2,722,400

Table 37. Ecosystem service values of individual springs with 5-mile buffers (high estimates).

	Water quality (nutrient removal/filtering)	Carbon sequestration (soil + biomass)	Flood attenuation and water regulation	Water clarity and aesthetics
Coffee Spring	$2,509,800	$5,295,150	$163,200	$277,200
Fanning Spring	$6,213,600	$5,290,170	$391,200	$890,100
Gilchrist Blue Spring	$5,010,700	$5,498,320	$354,000	$246,600
Hornsby Spring	$4,329,500	$4,935,560	$42,000	$333,900
Ichetucknee Springs	$1,366,000	$4,954,880	$67,200	$279,000
Lafayette Blue Spring	$3,744,900	$4,789,530	$234,000	$513,000
Little River Spring	$12,309,600	$7,191,750	$3,319,200	$671,400
Manatee Spring	$16,514,900	$9.460,070	$3,685,200	$892,800
Peacock State Park	$2,586,200	$4,330,610	$72,000	$394,200
Poe Spring	$3,782,300	$4,927,730	$78,000	$244,800
Poe Woods Spring	$3,672,400	$4,938,790	$69,600	$250,200
Rum Island Spring	$4,887,300	$5,416,830	$301,200	$258,300
Suwannee Blue Spring	$8,966,300	$6,981,740	$781,200	$441,900
Troy Spring	$10,127,000	$6,507,590	$2,593,200	$671,400
TOTAL	$86,020,500	$71,058,650	$12,151,200	$6,364,800

Table 38. Ecosystem service values of Spring Protection Areas (central estimates).

Spring Protection Area	Water quality (nutrient removal/filtering)	Carbon sequestration (soil + biomass)	Flood attenuation and water regulation	Water clarity and aesthetics
Troy Peacock LafayetteBlue Falmouth	$132,782,150	$98,320,840	$48,643,800	$40,213,600
Ichetucknee	$48,657,800	$25,915,790	$14,941,200	$13,847,200
Devil's Ear	$8,230,900	$7,662,280	$614,400	$2,282,800
Fanning Manatee	$11,463,500	$9,088,360	$5,049,600	$1,865,600
Columbia Hornsby Treehouse	$2,276,300	$1,550,820	$741,600	$538,800

Table 39. Ecosystem service values of Spring Protection Areas (high estimates).

Spring Protection Area	Water quality (nutrient removal/filtering)	Carbon sequestration (soil + biomass)	Flood attenuation and water regulation	Water clarity and aesthetics
Troy Peacock LafayetteBlue Falmouth	$249,349,700	$191,675,600	$97,287,600	$90,480,600
Ichetucknee	$92,335,000	$50,193,750	$29,882,400	$31,156,200
Devil's Ear	$16,257,000	$15,168,210	$1,228,800	$5,136,300
Fanning Manatee	$21,243,800	$17,694,350	$10,099,200	$4,197,600
Columbia Hornsby Treehouse	$4,305,400	$3,022,330	$1,483,200	$1,212,300

E.5 LIMITATIONS AND UNCERTAINTY

Several limitations should be considered when interpreting the ecosystem service valuation results.

First, as with all benefit transfer applications, estimated values are subject to transfer error, as values derived from previous studies may not perfectly reflect site-specific ecological conditions, management contexts, or population preferences (Boyd & Krupnick, 2009; U.S. EPA, 2016). To address this limitation, this study relied on valuation sources specific to Florida or the southeastern United States where possible and reported results using low, central, and high value ranges.

Second, per-acre ecosystem service values implicitly assume average ecosystem performance within each land cover category. In reality, ecosystem function varies spatially depending on factors such as hydrology, vegetation condition, management history, and landscape context. As a result, estimated values should be interpreted as order-of-magnitude approximations rather than precise site-level measurements.

Third, several ecosystem services—particularly water clarity and aesthetic benefits—were estimated using proxy values due to limited availability of per-acre valuation studies. These proxies are intended to provide conservative estimates suitable for comparative analysis but may underrepresent total recreational or cultural values associated with spring systems.

Fourth, this analysis does not capture nonlinear ecological responses, threshold effects, or interactions among ecosystem services. In addition, some services may be spatially correlated, and despite efforts to avoid double counting by assigning services conservatively, residual overlap cannot be entirely ruled out.

Finally, the results represent annual flow values and do not account for long-term dynamics, future land-use change, or temporal variability in ecosystem service provision. As such, valuation results are best interpreted as supporting relative comparisons, planning discussions, and prioritization decisions, rather than as estimates of total economic value.

Springs Preservation: Public Preferences and Policy Perspectives

Start of Block: Screener

Q1 What is your gender?

- Male (1)
- Female (2)
- Non-binary / third gender (3)

Q2 What is your age?

- Below 18 (1)
- 18-24 (2)
- 25-34 (3)
- 35-44 (4)
- 45-54 (5)
- 55-64 (6)
- 65 and above (7)

Q3 What is the highest level of education you completed?

Less than high school degree (1)

High school graduate (high school diploma or equivalent including GED) (2)

Some college but no degree (3)

Associate's degree in college or Technical college (2-year) (4)

Bachelor's degree in college (4-year) (5)

Graduate, Doctoral, or Professional Degree (6)

Q4 How many people live in your household, including yourself? (If you are a student, do not include your parents or roommates):

____

____

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Q5 Are you of Hispanic or Latino origin?

Yes (1)

No (2)

Q6 What is your race? Please select all that apply.

- ☐ White (1)
- ☐ Black or African American (2)
- ☐ American Indian or Alaska Native (3)
- ☐ Asian (4)
- ☐ Native Hawaiian or Pacific Islander (5)
- ☐ Other (6)

Q7 What is your current employment status?

- Full-time (1)
- Part-time (2)
- Unemployed (3)
- Retired (4)
- Student (5)
- Other (6)

End of Block: Screener

Start of Block: Knowledge of Springs

Q8 Please answer the following questions to the best of your ability.

Q9 According to water scientists, which of the following is a source of nutrient pollution?

- Septic tanks (1)
- Automotive fluids (2)
- Pesticides (3)
- Nuclear power plants (4)

Q10 According to water scientists, which of the following is one of the two primary nutrients of concern in Florida's waters?

- Nitrogen (1)
- Mercury (2)
- Chlorine (3)
- Sulfur (4)

Q11 According to water scientists, which of the following is one of the two primary nutrients of concern in your state’s waters?

- Phosphorous (1)
- Arsenic (2)
- Lead (3)
- Fluorine (4)

Q12 According to water scientists, which of the following is a challenge for agencies trying to limit pollution in freshwater springs?

- It can be difficult to determine where the pollution came from (1)
- Tests for measuring water quality are often unreliable (2)
- State and local authorities lack the authority to regulate public water bodies (3)
- It can be difficult to determine the chemical makeup of the pollutants (4)

Q13 Florida law references minimum flows and levels (MFLs). What does this mean?

The minimum water flow rate and level needed to prevent significant harm to a water resource (1)
The lowest water flow rate and level on record for a water resource (2)
The depth to which a well must be dug to pump groundwater that flows at a minimum rate (3)
The lowest speed at which surface water in an area moves downward to the level of groundwater (4)

Q14 What is the primary way the amount of water in the Floridan Aquifer increases?

Rainwater seeps through the soil (1)
Water flows downward through sinkholes and cracks in the ground surface (2)
Treated wastewater is pumped underground (3)
Water soaks in from lakes and rivers (4)

Q15 According to water scientists, which of the following are reasons that the water level in the Floridan Aquifer declines during droughts? Select all that apply.

☐ More water than usual is pumped from the aquifer (1)
☐ Less rain falls on the land above the aquifer (2)
☐ Water from the aquifer is given to other regions that don’t usually use the aquifer (3)

Q16 Which of the following best describes a spring?

An area where groundwater flows to the surface (1)

A well for extracting fresh water (2)

A lake with clear water (3)

A water source free of impurities (4)

Q17 Which of the following best describes an aquifer?

An underground layer where space between rocks and sediment is filled with water (1)

A drainage basin where rain water moves toward a common outlet (2)

An area where underground water bubbles or flows to Earth's surface (3)

Q18 What is the primary source of drinking water in North and Central Florida?

Underground water (1)

Rainfall collected in cisterns (2)

Surface water (3)

Ocean water with the salt removed (4)

Q19 Why are algae sometimes described by water scientists as harmful? Select all that apply.

☐ Algae can produce toxins that are dangerous to humans and animals (1)

☐ Algae can block sunlight from reaching other plants (2)

☐ Algae can increase oxygen to a level that is unsafe for fish (3)

☐ Algae can increase the amount of greenhouse gases in the atmosphere (4)

Q20 In which type of area is it most difficult for rain to soak into the ground?

Urban (1)
Agricultural Fields (2)
Forest (3)
Pasture (4)

Q21 Which of following best describes the change in the number of people living in the Floridan Aquifer region over the last ten years?

The number of people has increased (1)
The number of people hasn't changed very much (2)
The number of people has decreased (3)

End of Block: Knowledge of Springs

Start of Block: Description of Messages

Q22 The Upper Floridan Aquifer (UFA) is among the largest, most productive aquifers in the world and is a vital regional resource shared between Florida, southeastern Georgia, and other states (picture shown below). The aquifer is an interconnected system of groundwater that feeds to and from rivers, streams, and lakes. The Upper

Floridan Aquifer also contains springs, or areas where water from the aquifer emerges at the surface, which are popular recreational areas. Figure 1. Upper Floridan Aquifer Extent (Florida Springs Institute) Our Upper Floridan Aquifer (UFA) system provides a variety of benefits to Florida and Georgia including: Drinking water for over 11 million people in Georgia and Florida including rural communities. Water for agricultural activities worth over $7.5 billion in livestock and crop production, such as timber, peanuts, hay, carrots, and more. Recreational areas that support a billion-dollar nature tourism industry. Wildlife habitat for important species such as manatees, alligators and wading birds. There are over 300 freshwater springs in north Florida-- with over 19 first magnitude springs in this area. First magnitude springs are defined as one that discharges at least 100 cubic feet of water per second, which is equivalent to roughly 64.6 million gallons per day. This category represents the largest springs in the state. Florida's freshwater springs are currently managed through a combination of state agencies, including the Florida Department of Environmental Protection (FDEP), water management districts, and local governments, focusing on water quality restoration, land acquisition in spring recharge zones, and implementing Basin Management Action Plans (BMAPs). BMAPs are comprehensive management strategies designed to restore and protect the state's Outstanding Florida Springs by reducing nutrient pollution, primarily nitrogen, which is a major threat to their health. These plans focus on specific areas where springs are most impacted by activities like agricultural runoff and septic systems. We want to understand whether you believe that springs management is doing enough to protect the springs as it currently is, or if we need to implement a more rigorous springs management plan to protect freshwater springs in north Florida. Following this, you will be asked to read a message and state your level or support or opposition to various management issues.

End of Block: Description of Messages

Start of Block: Message 1: Control

Q23 Florida's freshwater springs are currently managed through a combination of state agencies, including the Florida Department of Environmental Protection (FDEP), water management districts, and local governments, focusing on water quality restoration, land acquisition in spring recharge zones, and implementing Basin Management Action Plans (BMAPs).

Q24 As a Florida resident, do you support or oppose a proposal to implement a more rigorous springs management plan to protect these benefits?

Strongly Support (1)
Support (2)
Neutral (3)
Oppose (4)
Strongly Oppose (5)

Q25 How strongly do you feel about your position related to springs management?

Strongly support (1)
Support (2)
Slightly support (3)

Q26 How strongly do you feel about your position related to springs management?

Strongly oppose (1)
Oppose (2)
Slightly oppose (3)

Q27 Why do you support or oppose this proposed springs management plan?

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Q28 What additional information would you need to support or oppose the proposal to increase protection Florida's freshwater springs?

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End of Block: Message 1: Control

Start of Block: Message 2: Economic + Loss

Q29 Florida’s freshwater springs are critical to our state’s economy, especially through tourism and recreation. However, without proper management, these springs face threats from pollution and environmental damage. If we don’t act now, the financial impact on local businesses and communities could be devastating, with potential declines in spring-based tourism and the cost of cleaning up polluted waters growing exponentially.

Q30 As a Florida resident, do you support or oppose the proposal to implement a more rigorous springs management plan to protect these benefits?

Strongly Support (1)
Support (2)
Neutral (3)
Oppose (4)
Strongly Oppose (5)

Q31 How strongly do you feel about your position related to springs management?

- Strongly support (1)
- Support (2)
- Slightly support (3)

Q32 How strongly do you feel about your position related to springs management?

- Strongly oppose (1)
- Oppose (2)
- Slightly oppose (3)

Q33 Why do you support or oppose the proposed springs management plan?

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Q34 What additional information would you need to support or oppose the proposal to protect Florida's freshwater springs?

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End of Block: Message 2: Economic + Loss

Start of Block: Message 3: Economic + Gain

Q35 Investing in the restoration and management of Florida’s freshwater springs can lead to significant economic benefits. By focusing on water quality restoration and sustainable land use, we can boost the local economy through increased tourism, enhance recreational opportunities, and create jobs related to conservation efforts. A healthier spring system is an asset that generates economic returns for Florida’s communities.

Q36 As a Florida resident, do you support or oppose the proposal to implement a more rigorous springs management plan to protect these benefits?

- Strongly Support (1)
- Support (2)
- Neutral (3)
- Oppose (4)
- Strongly Oppose (5)

Q37 How strongly do you feel about your position related to springs management?

- Strongly support (1)
- Support (2)
- Slightly support (3)

Q38 How strongly do you feel about your position related to springs management?

- Strongly oppose (1)
- Oppose (2)
- Slightly oppose (3)

Q39 Why do you support or oppose the proposed springs management plan?

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Q40 What additional information would you need to support or oppose the proposal to protect Florida's freshwater springs?

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End of Block: Message 3: Economic + Gain

Start of Block: Message 4: Ecological + Loss

Q41 Florida’s freshwater springs are essential to our state’s unique ecosystems, but they are facing severe degradation due to pollution and overuse. Without immediate action to protect and restore these vital water sources, we risk losing the biodiversity and natural beauty that define our state. These springs are the habitat for diverse species, and the longer we delay conservation efforts, the more difficult it will be to recover these ecosystems.

Q42 As a Florida resident, do you support or oppose the proposal to implement a more rigorous springs management plan to protect these benefits?

Strongly Support (1)

Support (2)

Neutral (3)

Oppose (4)

Strongly Oppose (5)

Q43 How strongly do you feel about your position related to springs management?

Strongly support (1)

Support (2)

Slightly support (3)

Q44 How strongly do you feel about your position related to springs management?

Strongly oppose (1)

Oppose (2)

Slightly oppose (3)

Q45 Why do you support or oppose the proposed springs management plan?

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Q46 What additional information would you need to support or oppose the proposal to protect Florida's freshwater springs?

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End of Block: Message 4: Ecological + Loss

Start of Block: Message 5: Ecological + Gain

Q47 Protecting Florida’s springs is not just about preserving water; it’s about safeguarding our natural heritage for future generations. Effective management and restoration of these vital ecosystems can help restore wildlife habitats, improve water quality, and protect Florida’s biodiversity. The benefits extend beyond just the environment — they enrich our quality of life by preserving the ecosystems that support wildlife, outdoor recreation, and the beauty of Florida.

Q48 As a Florida resident, do you support or oppose the proposal to implement a more rigorous springs management plan to protect these benefits?

- Strongly Support (1)
- Support (2)
- Neutral (3)
- Oppose (4)
- Strongly Oppose (5)

Q49 How strongly do you feel about your position related to springs management?

Strongly support (1)

Support (2)

Slightly support (3)

Q50 How strongly do you feel about your position related to springs management?

Strongly oppose (1)

Oppose (2)

Slightly oppose (3)

Q51 Why do you support or oppose the proposed springs management plan?

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Q52 What additional information would you need to support or oppose the proposal to protect Florida's freshwater springs?

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End of Block: Message 5: Ecological + Gain

Start of Block: NEP Scale

Q53 Please read the following statements about the environment and rate how much you agree with each statement based on your personal beliefs.

	Strongly Disagree (1)	Disagree (2)	A moderate amount (3)	Agree (4)	A great deal (5)
We are approaching the limit of the number of people the Earth can support. (1)					
Humans have the right to modify the natural environment to suit their needs. (2)					
When humans interfere with nature it often produces disastrous consequences. (3)					
Humans are seriously abusing the environment. (4)					
The Earth has plenty of natural resources if we just learn how to develop them. (5)					
Plants and animals have as much right as humans to exist. (6)					
The balance of nature is strong enough to cope with the impacts of modern industrial nations. (7)					

The so-called "ecological crisis" facing humankind has been greatly exaggerated. (8) The Earth is like a spaceship with very limited room and resources. (9) Humans were meant to rule over the rest of nature. (10) The balance of nature is very delicate and easily upset. (11)					
If things continue on their present course, we will soon experience a major ecological catastrophe. (12)					

End of Block: NEP Scale

Start of Block: Party Identification and Patterns of Use

Q54 What is your political affiliation?

Extremely liberal (1)

Liberal (2)

Moderate (3)

Conservative (4)

Extremely conservative (5)

Do not know/Prefer not to answer (6)

Q65 In the past 12 months, have you ever recreated in a freshwater spring in Florida?

Yes (1)
No (2)
I am not sure (3)

Q66 If yes, how often do you visit freshwater springs for recreation?

Once a year or less (1)
1-3 times a year (2)
4-6 times a year (3)
Once a month (4)
2-3 times a month (5)
Once a week (6)
Multiple times a week (7)

Q67 How likely are you to visit a freshwater spring in the next year?

Extremely unlikely (1)
Somewhat unlikely (2)
Neither likely nor unlikely (3)
Somewhat likely (4)
Extremely likely (5)

Q68 What types of recreational activities do you engage in when visiting freshwater springs? (Select all that apply)

☐ Swimming (1)

☐ Canoeing/Kayaking (2)

☐ Hiking (3)

☐ Wildlife viewing (4)

☐ Photography (5)

☐ Other: (6) ____

Q69 Do you typically visit the same freshwater spring, or do you visit different ones?

I visit the same spring (1)

I visit different springs (2)

Both (3)

End of Block: Party Identification and Patterns of Use

Start of Block: Cultural Cognition Theory Items

Q70 Please read the following statements about larger societal issues and rate how strongly you agree or disagree with them.

	Strongly Disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)
Society would be much better off if the people in charge imposed strict and swift punishment on those who break the rules. (1)					
Society is in trouble because people do not obey those in authority. (2)					
The best way to get ahead in life is to work hard to do what you are told to do. (3)					
We are all better off when we compete as individuals. (4)					
Even the disadvantaged should have to make their own way in the world. (5)					
Even if some people are at a disadvantage, it is best for society to let people succeed or fail on their own. (6)					
Society works best if power is shared equally. (7)					

What society needs is a fairness revolution to make the distribution of goods more equal. (8) It is our responsibility to reduce differences in income between the rich and the poor. (9) No matter how hard we try, the course of our lives is largely determined by forces beyond our control. (10) It would be pointless to make serious plans in such an uncertain world. (11)					
The most important things that take place in life happen by chance. (12)					

End of Block: Cultural Cognition Theory Items

APPENDIX G: FRAMING EXPERIMENT SPECIFICS

G.1 MODEL FIT STATISTICS

Hosmer-Lemeshow goodness-of-fit tests were run for all three models using estat gof, group(10) in Stata. Classification accuracy was assessed using estat class; Model 2 correctly classified 91.36% of observations. The likelihood ratio test comparing Model 1 and Model 2 confirmed that adding covariates significantly improved model fit (LR chi2(11) = 130.66, $p < 0.001$).

G.2 NEP SCALE RELIABILITY

Internal consistency of the 12-item NEP scale was assessed using Cronbach's alpha (alpha nep1-nep12 in Stata). Values above 0.70 indicate acceptable reliability; values above 0.80 indicate good reliability. [Insert alpha value from Stata output here.]

G.3 NOTE ON THE INTERACTION TERM

An interaction term between the ecological message indicator and the loss frame indicator (ecol x loss) was tested in Model 3 but was not statistically significant (OR = 0.67, $p > 0.10$). This indicates that the negative effect of loss framing on support was consistent across both ecological and economic message types and did not depend on message content. The interaction term was excluded from the final factorial model reported in Table 3.

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