Ecosystem Services and Riparian Land Management in the Merriland, Branch Brook and Little River Watershed

Photo courtesy of C. Feurt

Quantifying Values and Tradeoffs

George Perkins Marsh Institute at Clark University
Wells National Estuarine Research Reserve

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ECOSYSTEM SERVICES AND RIPARIAN LAND MANAGEMENT IN THE MERRILAND, BRANCH BROOK AND LITTLE RIVER WATERSHED

QUANTIFYING VALUES AND TRADEOFFS

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EXECUTIVE SUMMARY

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Management of the riparian land (or shore land) that borders New England's rivers and streams can require difficult choices. These often involve tradeoffs between the demand for development on this land and the protection of the valued services that naturally vegetated riparian land provides to the public—often called ecosystem services. People value these and other ecosystem services in the same way that they value goods and services purchased in markets. However, traditional economic assessments often overlook the economic benefits provided by ecosystem services. This leads to decisions that harm the public, because they overlook the economic value provided by the protection and restoration of natural systems. Quantifying the economic value of ecosystem services can help ensure that development and conservation decisions balance all benefits and costs.

This report summarizes an analysis of ecosystem service values provided by protection and restoration of riparian land in the Merriland, Branch Brook and Little River (MBLR) watershed in south coastal Maine. These results are drawn from *Choices for Our Land and Water: A Survey of Kennebunk, Sanford and Wells Residents*, conducted through a collaboration of Clark University and the Wells National Estuarine Research Reserve, and funded by the National Estuarine Research Reserve Science Collaborative. The survey evaluated the attitudes and preferences of community residents towards actions that would conserve and restore riparian land. It also included systematic voting (or choice experiment) questions that enable the economic value of local ecosystem services to be quantified. Results show the type of economic value that riparian land provides to the public, and the tradeoffs that the public would be willing to accept.

Survey development engaged a diverse set of residents, stakeholders, policy experts and public officials from Kennebunk, Sanford and Wells over three years of careful design and pretesting. The process included meetings with state and federal natural resource managers, town planners, scientists, and stakeholder groups; nine focus groups with community residents; and extensive pretesting. The survey was implemented by mail from December 2013 through January 2014. It was mailed to a sample of 3,816 randomly

selected MBLR residents split evenly across the three sampled towns (Kennebunk, Sanford and Wells), with systematic follow-up mailings to increase response rates. Out of 3,472 deliverable surveys, 1,126 were returned for an average response rate of 32.4%. Response rates were 27.0% in Sanford, 34.9% in Kennebunk and 35.1% in Wells.

Survey results demonstrate the types of economic value provided by natural riparian lands in the MBLR Watershed, and the extent to which local residents are willing to pay for programs that would enhance these valued natural resources and the ecosystem services they provide. Because these results are based on a random sample of Kennebunk, Sanford and Wells voters, they provide a more representative perspective on public values than is revealed by the small, self-selected and more vocal set of area residents who attend public meetings, are active in advocacy groups, or engage in other activities that influence public policy decisions. By providing a more representative perspective, the ecosystem service value results summarized here can help policymakers develop policies that more accurately reflect the values of all residents.

Some key findings of the study include:

- Residents of Kennebunk, Sanford and Wells place very high importance on environmental protection. The importance placed on environmental and ecosystem service protection is greater than that placed on the protection of landowner rights and prevention of tax increases.
- Residents hold considerable value for ecosystem services provided by riparian land. The value that people hold for riparian land restoration depends on how much land is restored, the effects on ecosystem services, and how restoration is accomplished. For example, residents are willing to pay for improvements in riparian land condition itself, as well as for improvements in the condition of local rivers, recreational fisheries, and swimming safety of local beaches that can result from the restoration of this land.

- All else equal, residents prefer management alternatives that increase restrictions on the development of riparian land (by increasing setback requirements) and that increase enforcement and inspections of these and other development restrictions. Residents prefer stronger regulation of development on riparian lands.
- Residents will support programs that restore and protect riparian land in the MBLR Watershed and associated ecosystem services, even if implementing these programs requires increases in the taxes and fees paid by their households.

The results of this study do not indicate what types of riparian land protection or restoration alternatives are right or wrong. Rather, the results predict which riparian land protection or restoration alternatives would be strongly supported by area residents because they are perceived as providing the greatest value. When combined with information on the projected ecological outcomes of riparian land management and the associated costs, results such as these can help identify management alternatives that best support the long term goals and values of residents, and generate the greatest sustainable economic value.

SECTION 1

Introduction—What Ecosystem Services Are Provided By Riparian Land?

Management of the riparian land (or shore land) that borders New England's rivers and streams can require difficult choices. These often involve tradeoffs between the demand for development on this land and the protection of the valued services that naturally vegetated riparian land provides to the public—often called ecosystem services. Riparian lands provide many valued ecosystem services. For example, naturally forested riparian land on river banks can filter out pollutants and sediments before they reach the water (leading to cleaner and clearer water); prevent the erosion and collapse of river banks; improve habitat for fish and wildlife; enhance local aesthetics; improve the environmental health of river systems; and prevent flooding of homes and property. Figure 1 illustrates some of the main ecosystem services provided by riparian land.

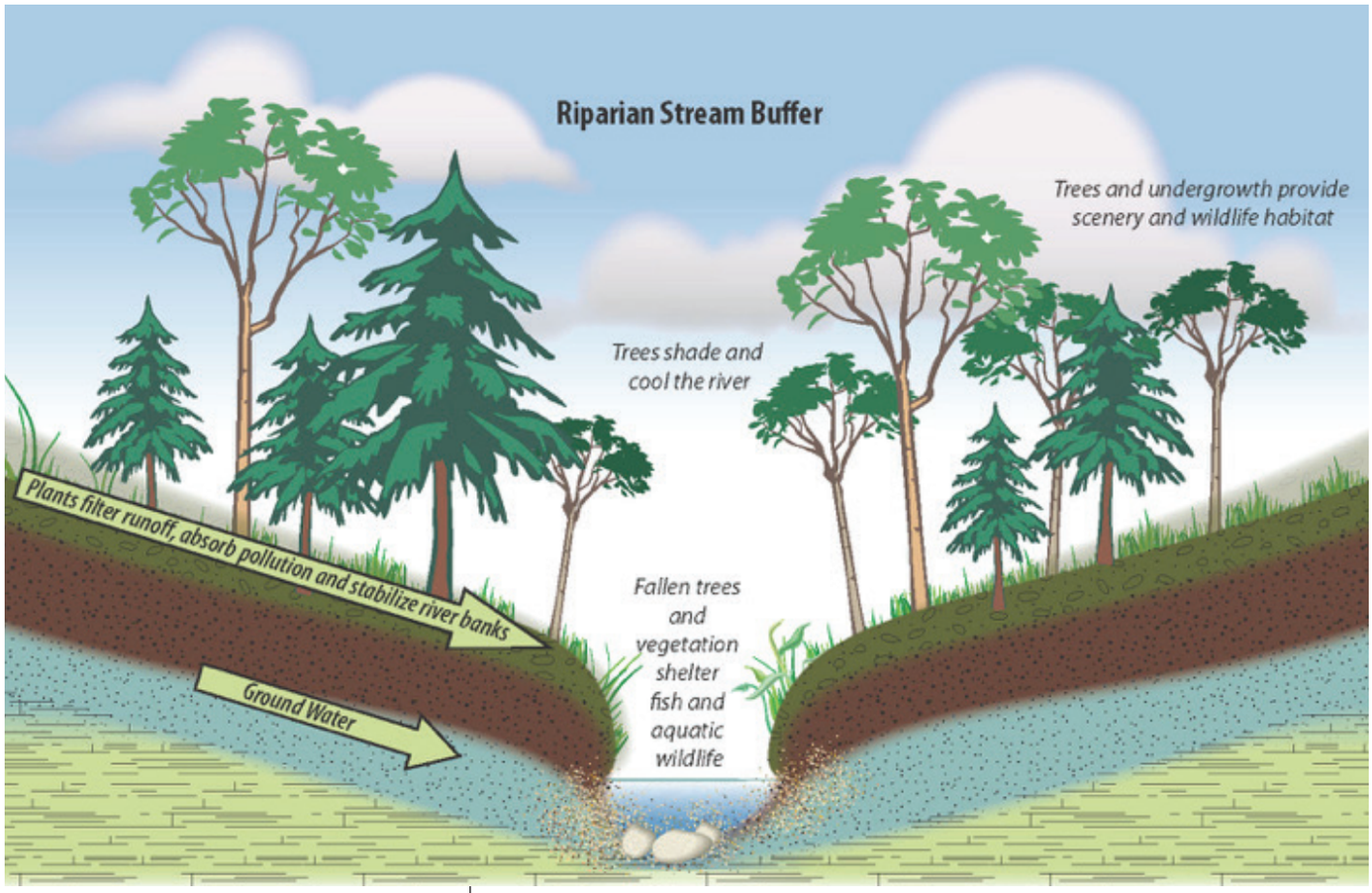

Figure 1: Natural Services of Riparian Land

People value ecosystem services like these in the same way that they value goods and services purchased in markets. In some cases ecosystem services are similar or identical to market goods and services (e.g., a fish caught in a local river may be nearly identical to a fish purchased in a market). In most cases, however, ecosystem services are not bought and sold. Because of this, traditional economic assessments (looking only at market transactions, jobs, income, etc.) overlook the economic benefits provided by these services. This can lead to decisions that harm the public, because they overlook the economic value provided by the protection and restoration of natural systems. Development of riparian land often benefits a very small group of people, for example homeowners who clear trees to obtain an improved view of the water. However, cutting down trees on this land can increase the flow of pollution and sediment

into local rivers, diminishing the water quality valued by thousands of residents and visitors. It can also diminish many other valued ecosystem services, such as the quality of local recreational fishing. Quantifying the economic value of ecosystem services can help ensure that development and conservation decisions balance all benefits and costs to all affected people.

1.1 CONTEXT FOR THE STUDY

This study evaluates the public's willingness to pay for ecosystem services that could be provided by riparian land management in the Merriland, Branch Brook and Little River (MBLR) watershed, located in the towns of Kennebunk, Sanford and Wells in south coastal Maine. This small coastal watershed in south coastal Maine has importance beyond the three municipalities where it originates, flows and connects to the ocean. For example, the Branch Brook provides drinking water during peak times for up to 75,000 people in portions of seven communities. The watershed also flows to one of the two focus estuaries of the Wells National Estuarine Research Reserve and through significant habitats of the Rachel Carson National Wildlife Refuge.

1.2 RIPARIAN LAND IN THE MBLR WATERSHED

Many scientists consider riparian land within about 300 feet of the water to be most important for ecosystem services. Today, there are roughly 4,700 acres of this land bordering freshwater rivers and streams in the MBLR Watershed (Figure 2). About 4,300 of these acres are covered by trees and other natural vegetation. The remaining acres have been developed or cleared. Currently, natural riparian land is being lost to development at a rate of about 5% (approximately 235 acres) every ten years. Without new action, this loss is likely to continue. Yet the conservation of riparian land requires tradeoffs. Many different actions are possible, yet available funds are rarely sufficient to protect all sites and resources. Protection of riparian land may also require restrictions on the development or clearing of private land. Thus, difficult choices must be made. Quantifying economic benefits and costs can help illustrate the consequences of these choices for the public.

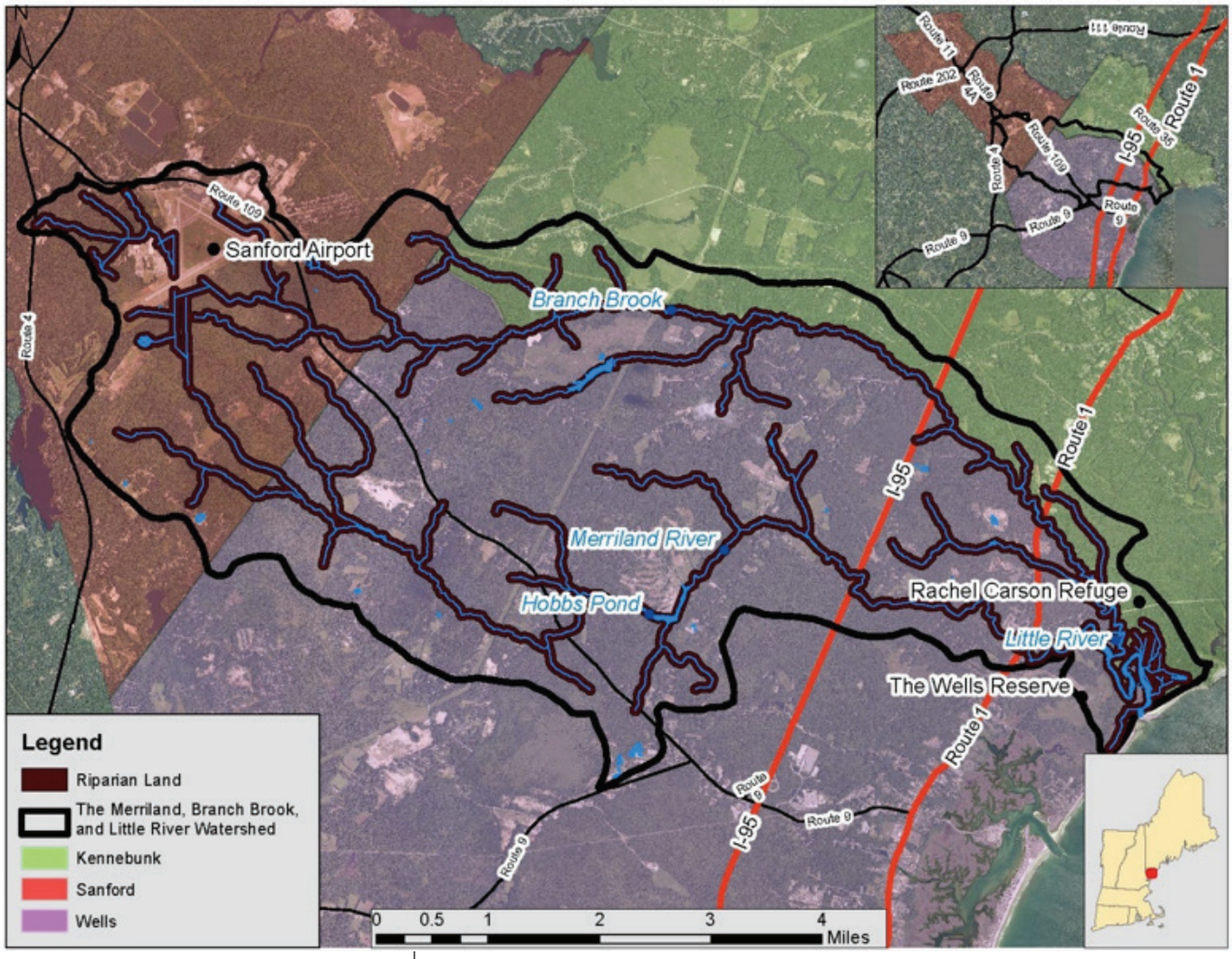

Figure 2: The Merriland, Branch Brook and Little River (MBLR) Watershed

1.3 THE GOAL OF THIS REPORT

This report summarizes an analysis of ecosystem service values provided by protection and restoration of riparian land in the MBLR Watershed. These results are drawn from *Choices for Our Land and Water: A Survey of Kennebunk, Sanford and Wells Residents,* conducted through a collaboration of Clark University and the Wells National Estuarine Research Reserve, and funded by the National Estuarine Research Reserve Science Collaborative. This survey evaluated the attitudes and preferences of community residents towards actions that

would conserve and restore riparian land. It also included systematic voting (or choice experiment) questions that enable the economic value of local ecosystem services to be quantified.[1] Results show the type of economic value that riparian land provides to the public, and the tradeoffs that the public would be willing to accept.

SECTION 2

Survey Design

Survey development engaged a diverse set of residents, stakeholders, policy experts and public officials from Kennebunk, Sanford and Wells over three years of careful design and pretesting. The process included meetings with state and federal natural resource managers, town planners, scientists, and stakeholder groups; nine focus groups with community residents[2]; and extensive pretesting. This survey development ensured that information in the survey was accurate and that the survey could be easily understood and answered by the public.

The goal of the survey was to understand residents' (a) attitudes concerning development, the rights of property owners, and conservation of riparian land, (b) values for the ecosystem services provided by riparian land, and (c) tradeoffs they would be willing to make to protect riparian land and the ecosystem services it provides. The survey included a wide range of attitudinal questions, along with referendum-style voting questions that enabled residents to vote for or against different types of hypothetical but realistic development and conservation alternatives for the MBLR Watershed. Results provide insight into the way that residents value riparian land in the MBLR watershed compared to other priorities such as the protection of landowner rights, and the specific types of tradeoffs they would be willing to accept in order to retain the services provided by riparian land in the watershed.

[1] For a discussion of the choice experiment approach, see Bateman, I. J., R. T. Carson, B. Day, M. Hanemann, N. Hanley, T. Hett, M. Jones-Lee, G. Loomes, S. Mourato, E. Özdemiroğlu, D. W. Pearce, R. Sugden, and J. Swanson. 2002. *Economic Valuation with Stated Preference Techniques: A Manual.* Cheltenham, UK: Edward Elgar.

[2] Within these focus groups, groups of randomly selected residents of Kennebunk, Sanford and Wells met with a moderator to freely discuss their perceptions, opinions, beliefs and attitudes related to the development and riparian land in the MBLR Watershed, and the types of policies they would support. Focus groups were also used to obtain feedback on preliminary drafts of the survey instrument.

SECTION 3

Survey Implementation and Response

The survey was implemented by mail from December 2013 through January 2014. It was mailed to a sample of 3,816 randomly selected MBLR residents split evenly across the three sampled towns (Kennebunk, Sanford and Wells), with systematic follow-up mailings to increase response rates. Out of 3,472 deliverable surveys, 1,126 were returned for an average response rate of 32.4%. Response rates were 27.0% in Sanford, 34.9% in Kennebunk and 35.1% in Wells. This is a high rate of return for a mail survey, and suggests the relevance of the topic to the public. Figure 3 shows the approximate home locations of those residents who did and did not return a completed survey.[3] The demographic characteristics of those who responded to the survey are shown in Appendix I.

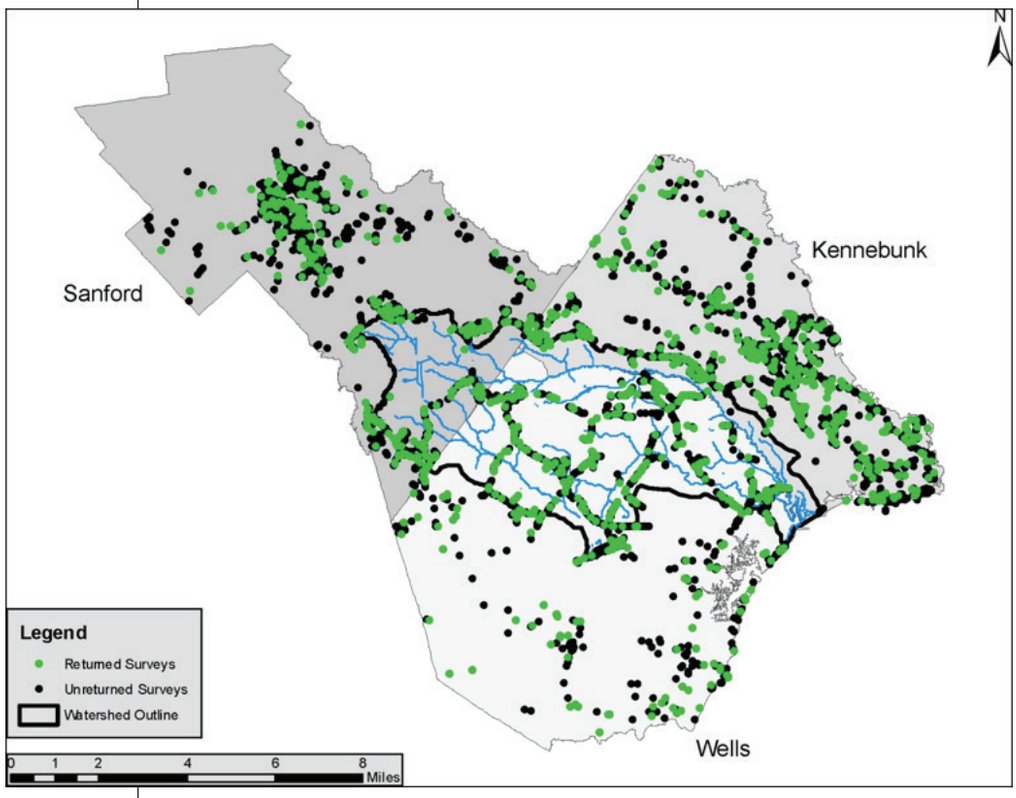

Figure 3: Approximate Location of Survey Respondents

[3] These locations are perturbed, or moved slightly to prevent identification of specific home addresses.

SECTION 4

Residents' Attitudes Concerning Development and Riparian Land

The first section of the survey asked respondents to indicate the importance of statements related to development, property rights and the protection of riparian land in the watershed. These statements were rated on a scale of 1 to 5, where 1 = Not at all important and 5 = Very important. Because these statements were rated independently, the responses cannot be used to quantify tradeoffs (e.g., how much of one outcome respondents would be willing to give up in exchange for increases in others). However, they provide insight into the extent to which residents care about different types of priorities.

4.1 Protecting the Environment

Survey responses show the high importance placed on environmental protection. This was greater than the importance placed on all other priorities, including the protection of landowner rights and prevention of tax increases. Over 85% of respondents indicated that it was "very important" that water quality is protected in lakes rivers and streams—the highest possible importance category (Figure 4). Only 1% of respondents indicated that this was less than moderately important. Similarly, over 72% of respondents indicated that it was "very important" to protect the local environment (Figure 5). Only 1% indicated that it was less than moderately important.

4.2 Respecting the Rights of Private Landowners

Some approaches to protect the natural environment require limiting the actions of private landowners, such as restricting development within a certain distance of rivers and streams. Survey respondents had mixed feelings regarding the importance of respecting landowners' rights, and most did not consider it to be a high priority. Less than 35% of respondents stated that it was "very important" that government respects the right of private landowners to develop their land, whereas

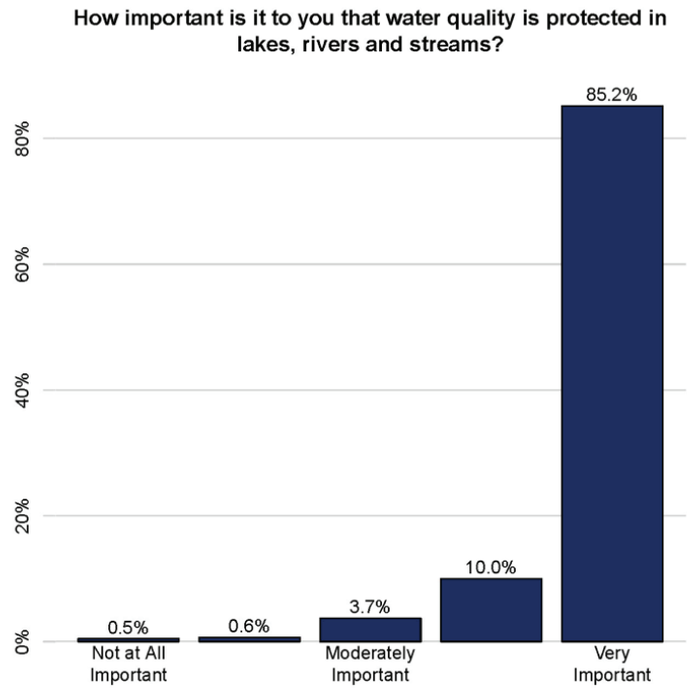

Figure 4: Importance of Water Quality Protection

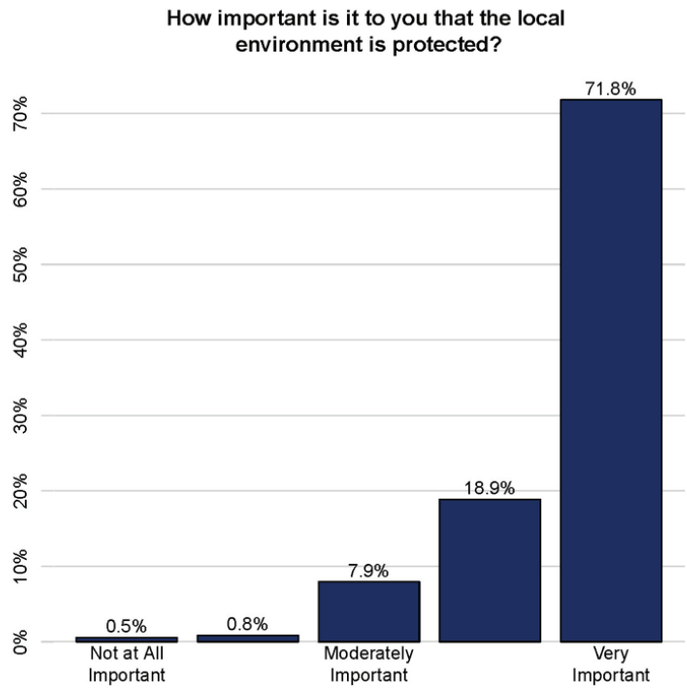

Figure 5: Importance of Environmental Protection

43% indicated that this was of moderate importance or less (Figure 6). Similarly, only 33% of respondents indicated it was "very important" that existing uses of private land are grandfathered, so that they are not subject to new restrictions. Approximately 47% stated that grandfathering existing land uses was of moderate importance or less (Figure 7).

4.3 Fairness and Effectiveness of Land Use Regulations

In contrast to protecting the rights of landowners (which had only moderate importance on average), the fairness and effectiveness of land use regulations was considered to be very important. Approximately 65% of respondents considered it "very important" that existing regulations are enforced fairly and effectively (Figure 8). Only 2% of respondents considered this to be less than moderately important.

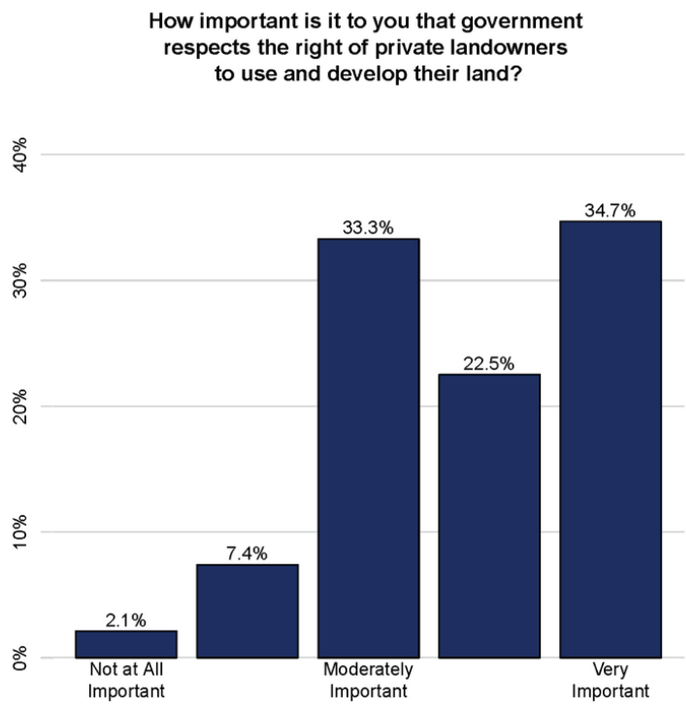

Figure 6: Importance of Landowner Rights

4.4 Preventing Tax Increases

Actions to restore and protect riparian land can be costly, and one way to fund programs is through public taxes and fees. It is often believed that preventing tax increases is a top priority of many people. Results of the survey question this common wisdom. Although preventing tax increases is very important to some people, it is less important on average than many other priorities. Only 44% of respondents considered it "very important" that taxes and fees paid by their households do not increase (in order to protect natural riparian land). Approximately 37% of respondents stated that preventing tax increases was moderately important or less (Figure 9).

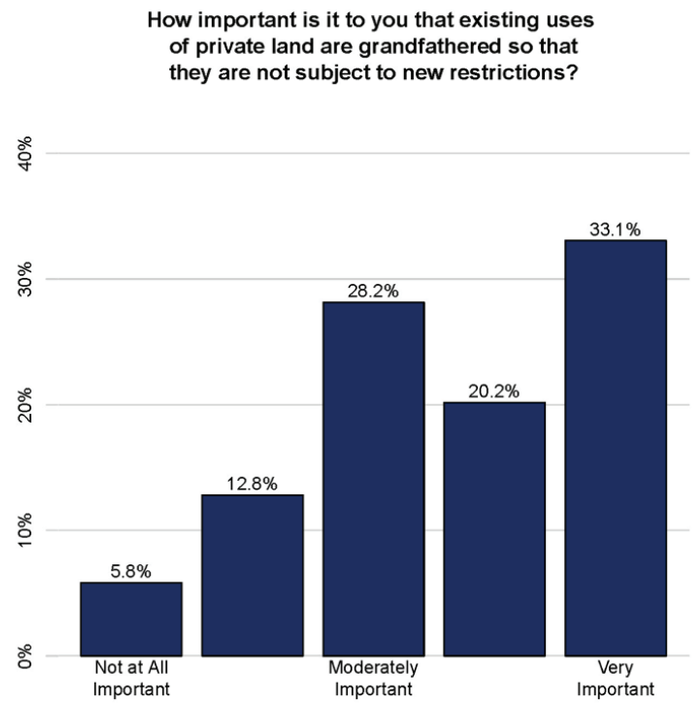

Figure 7: Importance of Grandfathering Land Uses

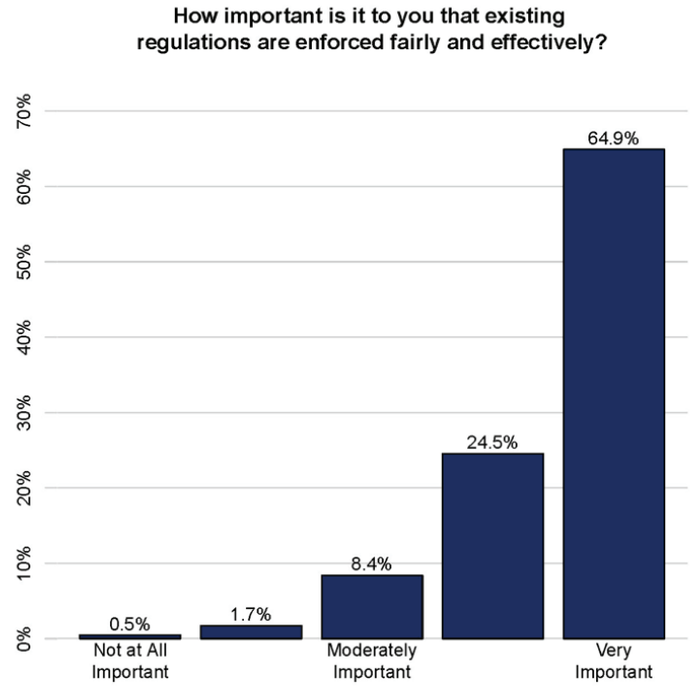

Figure 8. Importance of Fair and Effective Enforcement

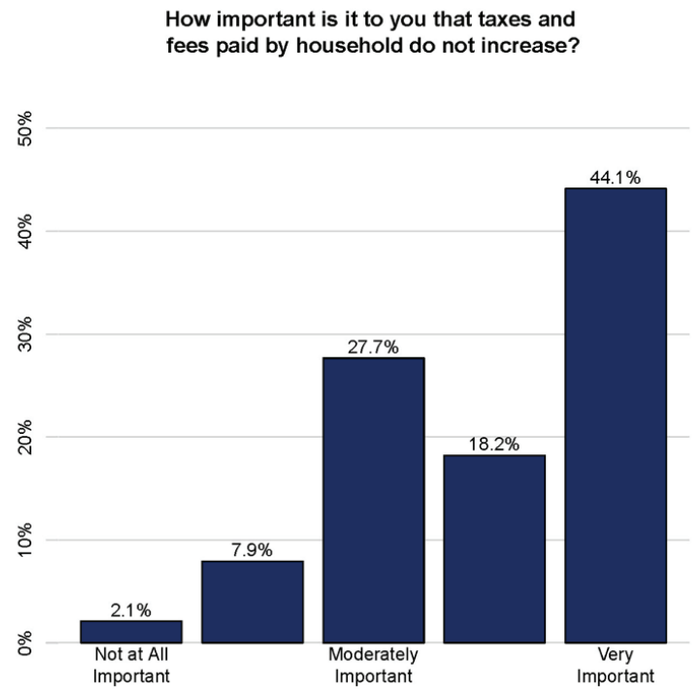

Figure 9. Importance of Preventing Tax Increases

4.5 Do Residents Support Greater Development Restrictions in General?

Survey results show that residents support the increased use of development setbacks (when development is required to be a certain minimum distance from the water) and land inspections to protect riparian land in the MBLR Watershed. As shown by Figure 10, over 73% of respondents indicated that they "support greater use of development setbacks and land inspections to limit future development on riparian land." Only 13% of respondents did not support greater use of these tools (the remaining 14% were unsure).

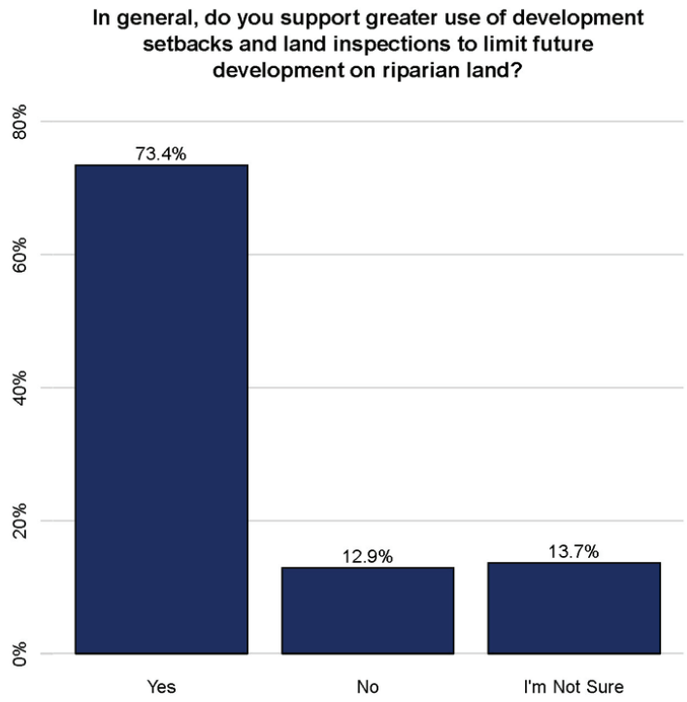

Figure 10. General Support for Development Setbacks and Inspections

SECTION 5

Quantifying Ecosystem Service Values

One of the primary goals of the survey was to evaluate the types of tradeoffs that would be supported by Kennebunk, Sanford and Wells residents, when considering different ways to protect and restore riparian land in the MBLR Watershed. One of these tradeoffs is respondents' willingness to give up money (e.g., accept increased taxes or fees) to obtain different types of riparian land protection programs, with different effects. This is interpreted as residents' willingness to pay (WTP), and may be used to quantify their values for the ecosystem services delivered under each plan.[4]

For example, assume that a person would vote "yes" for a program that would increase her tax bill by $100, in return for a specific set of ecosystem service improvements. That positive vote indicates that the person values the environmental improvements by at least $100—otherwise they would not support the program. This is the same way that market purchases reveal economic values, by showing the monetary tradeoffs that people are willing to make. By modeling how residents would vote for or against different possible programs to protect riparian land—with different costs and effects on ecosystem services—it is possible to calculate the value of ecosystem services to those residents.

To evaluate the tradeoffs supported by Kennebunk, Sanford and Wells residents, surveyed households were asked to choose among different types of programs to protect and restore riparian land in the MBLR Watershed, within referendum-style voting questions called choice experiments. Each voting choice was described in terms of projected effects on natural riparian land, the condition of local rivers, abundance of recreational fish in those rivers, the safety of water at local beaches for swimming, development restrictions and inspections, and annual household costs. Each of these voting questions asked the respondent to choose between two hypothetical but feasible protection programs with different effects and costs, and a "business as usual" alternative with no additional cost (i.e., Option A versus Option B versus Neither [N], or A-B-N). Seventy-two hypothetical A-B-N choices were developed, and divided randomly among surveys sent to different households. Each of these questions illustrated a different set of

[4] More generally, willingness to pay is defined as the maximum amount of money that a person (or group) would be willing to give up in exchange for a specified quantity of a good or service, rather than go without. It is the measure most commonly used by economists to quantify value.

riparian land protection programs. Each household was asked to answer three of the seventy-two A-B-N choices. The combined votes of all households over all of these hypothetical A-B-N choices were used to calculate the tradeoffs households were willing to make, based on their observed votes. This rigorous, systematic design helps to ensure the validity of results.

Possible effects of each hypothetical riparian land management program over the next 10 years ("Comparing Protection Options"—Figure 11) used as a basis for the A-B-N choices were derived from scenarios for the MBLR Watershed. These were developed in coordination with scientists at the Wells National Estuarine Research Reserve, based on available ecological data collected from local watersheds specifically for this study. Within each question, each alternative (A, B or N) shows a possible outcome of riparian land protection and/or restoration in the watershed. The initial effect of riparian land programs is to increase the number of naturally vegetated riparian acres, described by the attribute Riparian Land Condition. The predicted consequences include (1) changes in the ecological condition of area rivers (River Condition), calculated using an aquatic biotic index; (2) changes in the relative abundance of recreational fish (Recreational Fish), quantified using MBLR sampling data on brook trout; and (3) changes in the safety of water quality for swimming at area beaches (Safe Swimming), characterized using data on water quality testing from the Maine Healthy Beaches Program. In addition to these ecological outcomes, some of the presented programs would change the minimum width of the riparian area in the MBLR Watershed within which development would be restricted (Development Setbacks), and whether enforcement and inspections would be increased to prevent illegal development and clearing on riparian land (Enforcement). Annual household cost (Cost) was characterized as an unavoidable increase in taxes and fees required to implement each restoration plan.

Figure 12 shows an example of the type of A-B-N choices included in the survey. The annual household costs presented in each A-B-N choice are hypothetical. Some programs include higher costs and others include lower costs, to evaluate how changes in these costs affect residents' votes for or against different types of programs.

COMPARING PROTECTION OPTIONS

The upcoming questions will ask you to compare different ways of protecting riparian land in Kennebunk, Sanford and Wells, and vote for the ones you prefer. You may also vote to reject the proposed programs and retain the status quo. **Effects of each option will be described by the following effects, as estimated by scientists:**

Effect	What it Means
 **Natural Riparian Land**	The amount of riparian land covered by natural vegetation. Currently about 91% of the land is in natural condition. With no action **85%** of riparian land in the area (4000 acres) will remain in natural condition in 5-10 years.
 **River Ecology**	Average ecological condition of area rivers, measured by the diversity of small organisms (dragonflies, mayflies, etc.) that live there. A score of 100% is the best possible condition in the area. A score of 0% means nothing lives in the water. With no action, the ecological condition in area rivers will be **55%** in 5-10 years. The score today is about 60%.
 **Recreational Fish**	The number of recreational fish in area rivers, measured by scientific sampling of brook trout. A score of 100% would mean that area rivers contain the maximum number of trout possible (30 trout per 1000 sq. feet). Today there are about 19 trout per 1000 sq. feet. With no action, scientists predict there will be an average of 17 trout per 1000 sq. feet (**55%** of the most possible) in 5-10 years.
 **Safe Swimming**	The percentage of days in which government tests show that area beaches (Laudholm, Drakes Island, Crescent Surf, and Parson) are safe for swimming. 100% means that all tests show water safe for swimming. With no action, scientists predict **85%** of tests will show water safe for swimming in 5-10 years.
 **Development Setback**	The minimum width of the riparian area where development is restricted. Currently development and clearing is restricted within a minimum distance of **100 feet from rivers** and **25 feet from streams**. This distance is larger in some areas and for some types of development. Existing (legal) development would be grandfathered if setbacks change.
 **Enforcement**	Whether enforcement is increased to prevent illegal development or clearing on riparian land. This could include inspections on private land if violations are suspected. Currently, inspections can only occur when a violation has been reported or as part of permitting.
$ **Cost to your Household per Year**	How much the policy will cost your household in unavoidable annual taxes and fees. These are guaranteed to only be spent on the protection option that is indicated.

Figure 11. Effects and Costs of Riparian Land Management Included in Choice Questions

YOU WILL BE ASKED TO VOTE

After considering the current situation and possible protection effects and methods, which do you prefer? You will be given choices and asked to vote for the option you prefer by checking the appropriate box. **Questions will look similar to the sample below.**

SAMPLE QUESTION:

Method or Effect of Protection	In 5-10 years under the Current Situation	In 5-10 years under Option A	In 5-10 years under Option B
Riparian Land Condition	**85%** 4000 out of 4700 riparian acres covered by natural vegetation	**87%** 4100 out of 4700 riparian acres covered by natural vegetation	**95%** 4500 out of 4700 riparian acres covered by natural vegetation
River Ecology	**55%** of best possible (100%) ecological condition	**85%** of best possible (100%) ecological condition	**85%** of best possible (100%) ecological condition
Recreational Fish	**55%** 17 out of 30 possible fish per 1000 sq. feet	**75%** 23 out of 30 possible fish per 1000 sq. feet	**55%** 17 out of 30 possible fish per 1000 sq. feet
Safe Swimming	**85%** of beach tests meet safe swimming guidelines	**95%** of beach tests meet safe swimming guidelines	**85%** of beach tests meet safe swimming guidelines
Development Setback	**100 feet** required between development and rivers; 25 feet for streams	**150 feet** required between development and rivers; 75 feet for streams	**100 feet** required between development and rivers; 25 feet for streams
Enforcement	**No Change** in enforcement and inspections	**No Change** in enforcement and inspections	**Increased** enforcement and inspections
$ Cost to your Household per Year	**$0** Increase in Annual Taxes or Fees	**$45** Increase in Annual Taxes or Fees	**$5** Increase in Annual Taxes or Fees
HOW WOULD YOU VOTE? (CHOOSE ONLY ONE) I vote for	X NO NEW PROTECTION	X I vote for OPTION A	X I vote for OPTION B

If you prefer **No New Action** Check Here

If you prefer **Option A** Check Here

If you prefer **Option B** Check Here

Figure 12. Example Choice Question

Prior to each choice, the survey presented information on the situation in the MBLR Watershed, as well as the different types of riparian land protection actions that could be used. Maps and graphics were included to illustrate the effects of these actions. All materials were subjected to extensive pretesting and revision over the three year survey development process. This process ensured that survey information and questions were clear and easily understood, and that questions addressed outcomes that were important to community residents.

5.1 Ecosystem Service Values and Riparian Land Protection

The choices of Kennebunk, Sanford and Wells residents show strong support for riparian land protection and/or restoration, even if it requires new taxes and fees. These findings mirror results from the attitudinal questions discussed above. The choices also demonstrate the value of different types of protection outcomes (e.g., changes in ecosystem services).

Table 1 shows the value of each protection outcome and method (described in Figure 10) to an average household in the survey sample, based on observed votes. These may be interpreted as the amount that an average household would be willing to pay per year, in additional and reoccurring town taxes and fees, to obtain each of these outcomes. These are average values for each respondent household and reflect a WTP per year, in perpetuity. These results show that the value placed on riparian land protection depends on what is protected and how.

These results can be used to calculate residents' total value for different types of ecosystem service changes, and also to illustrate the tradeoffs that residents are willing to make. For example, increasing the number of brook trout in MBLR rivers by 1 fish per 1000 square feet (which as a value of $3.83 per household, per year) would have the same value to residents as restoring natural vegetation on 87.88 acres of riparian land (value = 87.89 × $0.04 ≈ $3.83 per household, per year). The same value would be provided by a program that increased the percentage of safe swimming days by 1.90 (value = 1.90 × $2.02 ≈ $3.83 per

Table 1. Economic Value of Riparian Land Protection Outcomes

Outcome	Description of Outcome *(All effects are within the MBLR Watershed)*	Value per Household, per Year *(Additional taxes/fees that each household would be willing to pay, per year)*
Riparian Land Condition	The number of riparian acres with natural vegetation.	**$0.044** per additional acre with natural vegetation.
River Condition	The average ecological condition of area rivers, measured using a 100-point aquatic biotic index.	**$1.280** per point increase in the biotic index
Recreational Fish	The average number of brook trout per 1000 square feet of river.	**$3.833** per additional fish, per 1000 square feet of river
Swim Safety	The percentage of days during which government tests show that area beaches (Laudholm, Drakes Island, Crescent Surf and Parson) are safe for swimming.	**$2.020** per percentage point increase in safe swimming days
Setbacks	The minimum width of the riparian area where development is restricted, in feet.	**$0.140** per foot of **increased** development setbacks.
Enforcement	Whether enforcement is increased to prevent illegal development or clearing on riparian land.	**$17.310** for increased enforcement and inspections, compared to the status quo

household, per year). Results such as these can be used to calculate the type of programs that would be most valued by residents of the area, and how to best design programs to meet residents' priorities.

Results also show that increases in minimum development restrictions (setbacks) and enforcement are positively valued by local residents—residents are more likely to support riparian land protection programs if those programs involve stronger restrictions on development, holding all else constant. This finding contradicts common wisdom that Maine residents would not support development restrictions to obtain improved environmental outcomes.

These results can also be used to quantify the combined value of riparian land protection or restoration to Kennebunk, Sanford and Wells residents. For example, consider a hypothetical riparian land protection and restoration plan that would lead to the following projected outcomes within the MBLR Watershed: (1) restore natural vegetation on 200 acres of currently cleared riparian land, (2) increase

the ecological condition of rivers by 5 points on the 100 point aquatic biotic scale, (3) increase the average number of brook trout by 3 fish per 1000 square feet of river, (4) have no effect on the safety of local beaches for swimming, (5) make no change in required development setbacks, (6) increase enforcement and inspections of development restrictions on private land. Table 2 shows the total value of this plan, both to each household (on average) and to the three communities as a whole.

The illustrative scenario in Table 2 is just one of many examples that can be developed using the choice experiment results. As shown by Tables 1 and 2, residents of Kennebunk, Sanford and Wells receive considerable value from the potential outcomes of riparian land restoration, as reflected in their WTP. If given a choice, residents would vote to support programs (such as local bond issues) that would generate increased ecosystem services from riparian land in the MBLR Watershed, even if those programs required additional taxes and fees. For example, assume that the program described above were offered to Kennebunk, Sanford and Wells voters at an average household cost of $20 per year (e.g., in additional property tax payments to support a local bond). Model results predict that 73.7% of residents would vote 'yes' for this proposal. This support reflects the personal value that the ecosystem services of riparian land provide to residents. Of course, residents' willingness to support any public program depends on a variety of other factors as well, including whether a program is viewed as feasible and whether funds are guaranteed to be spent for the intended purposes. Residents are also willing to accept greater restrictions on the use of private lands, and indeed are more likely to vote for programs that include more strict regulation of development in the riparian zone, and additional enforcement.

The survey also included questions to evaluate the validity of these results, and how respondents felt about the survey. The vast majority of respondents viewed the survey instrument favorably. Most indicated that the information and questions were easy to understand, that

Table 2. Illustrative Economic Value of a Hypothetical Riparian Restoration Plan in the MBLR Watershed

(A) Projected Outcome	(B) Additional Taxes/Fees that Each Household would be Willing to Pay — See Table 1	(C) Total Value per Household, Per Year (= A×B)
Restore natural vegetation on 200 acres of riparian land	$0.044 per acre	**$8.72**
Increase ecological condition of rivers by 5 points on aquatic biotic index	$1.28 per point	**$6.40**
Increase the average number of brook trout by 3 fish per 1000 square feet of river	$3.833 per fish	**$11.50**
No effect on the safety of local beaches for swimming	$2.02 per percentage point increase in safe swimming days	**$0.00**
No change in required development setbacks	$0.140 per foot	**$0.00**
Increase enforcement and inspections	$17.31 for increased enforcement and inspections	**$17.31**
Total Plan Value per Household Per Year The amount that an average household would be willing to pay in additional taxes and fees, per year and in perpetuity, to obtain these combined outcomes		**$43.93** per household, per year (Equivalent to a total of **$760,443** per year, in perpetuity, when multiplied by all 17,309 households of Kennebunk, Sanford and Wells.)[5,6]

[5] As of the 2010 Census there were 4,120 households in Wells, 4,689 in Kennebunk and 8,500 in Sanford.

[6] For example, over 20 years, this would imply that Kennebunk, Sanford and Wells residents would be willing to pay a total of $15.2 million in additional taxes and fees (20 × $760,443), in order to obtain these outcomes. This reflects the value they receive.

survey content was fair and balanced and that they were confident about their answers. For example, 76% of respondents agreed or strongly agreed that they felt confident in their survey answers, and 83% of respondents agreed or strongly agreed that they would vote the same way in a binding referendum.

5.2 Are these Real Economic Values?

These values are derived from a survey instrument and not a real binding vote. If given an actual choice (say, in a real binding vote), would people *really* pay these amounts? Although there is concern among some economists that surveys such as this can generate inflated value estimates, comparisons to actual binding referenda show that well-designed surveys such as this accurately predict people's votes and values.[7] Hence, while there is some degree of uncertainty in all scientific measurements (including measurements of economic value), the results provided here provide strong evidence that Kennebunk, Sanford and Wells residents receive considerable value from the ecosystem services of riparian land, and would vote for programs that enhance these services.

[7] Johnston, R.J. 2006. Is Hypothetical Bias Universal? Validating Contingent Valuation Responses Using a Binding Public Referendum. *Journal of Environmental Economics and Management* 52(1): 469-481.

SECTION 6

Conclusion

Quantifying the ecosystem service values and tradeoffs associated with environmental management alternatives can provide information crucial for policy design and to identify the often overlooked benefits of policies that enhance ecosystem sustainability. Results of the survey *Choices for Our Land and Water: A Survey of Kennebunk, Sanford and Wells Residents* demonstrate the types of economic value provided by natural riparian lands in the Merriland, Branch Brook and Little River Watershed, and the extent to which local residents are willing to pay for programs that would enhance these valued natural resources and the ecosystem services that they provide. These results are based on a random sample of Kennebunk, Sanford and Wells residents. Hence, they provide a more representative perspective on public values than is revealed by the small, self-selected and more vocal set of area residents who attend public meetings, are active in advocacy groups, or engage in other activities that influence public policy decisions. By providing a more representative perspective, the ecosystem service value results summarized here can help policymakers develop policies that more accurately reflect the values of all residents, not just a select few.

Some key findings of the study include:

- Residents of Kennebunk, Sanford and Wells place very high importance on environmental protection. The importance placed on environmental and ecosystem service protection is greater than that placed on the protection of landowner rights and prevention of tax increases.
- Residents hold considerable value for ecosystem services provided by riparian land. The value that people hold for riparian land restoration depends on how much land is restored, the effects on ecosystem services, and how restoration is accomplished. Residents are willing to pay for improvements in riparian land condition

itself, as well as for improvements in the condition of local rivers, recreational fisheries, and swimming safety of local beaches that can result from the restoration of this land.

- All else equal, residents prefer management alternatives that *increase* restrictions on the development of riparian land (by increasing setback requirements) and that increase enforcement and inspections of these and other development restrictions. Residents prefer stronger regulation of development on riparian lands.
- Residents will support programs that restore and protect riparian land in the MBLR Watershed and associated ecosystem services, even if implementing these programs requires increases in the taxes and fees paid by their households.

The results of this study do not indicate what types of riparian land protection or restoration alternatives are right or wrong. Rather, the results predict which riparian land protection or restoration alternatives would be strongly supported by area residents because they are perceived as providing the greatest value. When combined with information on the projected ecological outcomes of riparian land management and the associated costs, results such as these can help identify management alternatives that best support the long term goals and values of residents, and generate the greatest sustainable economic value.

APPENDIX I DEMOGRAPHIC PROFILE OF THE RESPONDENTS

The survey was mailed to a random sample of residents in Kennebunk, Sanford and Wells, including all residents of the MBLR Watershed. The following summarizes the characteristics of those who responded. These results suggest that responses were received from a wide range of demographic groups, but the sample was of somewhat greater age, income and education than the general population. Females were more likely to respond than males.

Selected Socio-demographic Characteristics of the Survey Sample (Survey Responses)

What is your gender?

Female	Male
55.0%	45.0%

What is your age?

20-29	30-39	40-49	50-59	60-69	70-80	More than 80
2%	8%	14%	28%	26%	17%	6%

Do you live in the Merriland, Branch Brook and Little River Watershed?

Yes	No	Not Sure
55%	32%	13%

What is the highest level of education you have completed?

Less than high school	High School/GED	Some college	2~Year college	4~Year college	Graduate Degree (MS, PHD, etc.)
1%	17%	19%	14%	31%	19%

How long have you been a Maine resident?

Less than 5	5~19	20~34	35~49	50~65	More than 65
6%	23%	26.%	19%	18%	9%

What category best describes your total household annual income?

Less than $10,000	$10,000~ $19,999	$20,000~ $39,999	$40,000~ $59,999	$60,000~ $79,999	$80,000~ $99,999	$100,000~ $249,999	$250,000~ or more
2%	7%	18%	19%	17.%	13%	20%	3%

Of the final survey sample, 33.7% of returned surveys were from Kennebunk residents, 33.1% were from Sanford residents, and 33.2% were from Wells residents.

APPENDIX II

TECHNICAL DETAILS OF THE CHOICE MODEL AND RESULTS

Table A.1 shows the statistical results underlying the value estimates provided in Table 1. The random utility model for the choice experiment was estimated using mixed logit with Halton draws, allowing for correlations across multiple responses from each respondent. The model predicts the choices (or votes) that were made by each survey respondent, as a function of the attributes of the riparian land protection plans they considered. The final specification was chosen after the estimation of preliminary models with varying specifications of fixed and random coefficients. Coefficients on an alternative specific constant for the status quo (ASC), *Recreational Fish, Safe Swimming, Development Setbacks,* and *Enforcement* are specified as random with a normal distribution. The coefficient on Cost (sign-reversed) is random with a bounded triangular distribution, ensuring positive marginal utility of income. The coefficients on *Riparian Land Condition and River Condition* are specified as non-random. The model is statistically significant at $p<0.0001$, with all coefficient estimates on fixed and random parameters statistically significant at $p<0.01$. Willingness to pay estimates reported in Tables 1 and 2 are calculated from these results. Very similar results are derived from other specifications of the model (i.e., the results are statistically robust).

Table A.1. Mixed Logit Model Results

Chi squared [13 d.f.] 1174.99325
Significance level 0.00000
McFadden Pseudo R-squared 0.2411012
Number of obs.= 2218

	Coefficient	Standard Error	Z	Prob. |z|>Z*	95% Confidence Interval	
Random parameters in utility functions						
NEITHER	-3.26424***	0.51291	-6.36	0.0000	-4.26952	-2.25896
FISH_PCT	0.04075***	0.00596	6.84	0.0000	.02907	0.05243
SWIM_PCT	0.07220***	0.01322	5.46	0.0000	.04629	0.09811
SETBACK_	0.00541***	0.00182	2.98	0.0029	.00185	0.00897
ENFORCE	0.64542***	0.11486	5.62	0.0000	.42031	0.87054
NEG_COST	0.04932***	0.00504	9.80	0.0000	.03945	0.05919
Nonrandom parameters in utility functions						
LAND_PCT	0.07392***	0.01680	4.40	0.0000	.04099	0.10685
WATER_PC	0.04546***	0.00566	8.03	0.0000	.03436	0.05656
Distns. of RPs. Std. Devs or limits of triangular						
NsNE	6.70172***	0.67433	9.94	0.0000	5.38006	8.02337
NsFISH_P	0.03404*	0.01758	1.94	0.0529	-.00042	0.06849
NsSWIM_P	0.05711	0.03967	1.44	0.1499	-.02063	0.13486
NsSETBAC	0.02565***	0.00370	6.94	0.0000	.01840	0.03289
NsENFORC	1.07711***	0.25742	4.18	0.0000	.57258	1.58165
TsNEG_CO	0.04932***	0.00504	9.80	0.0000	.03945	0.05919

Photo courtesy of C. Feurt

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